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108-1031 USA Doc

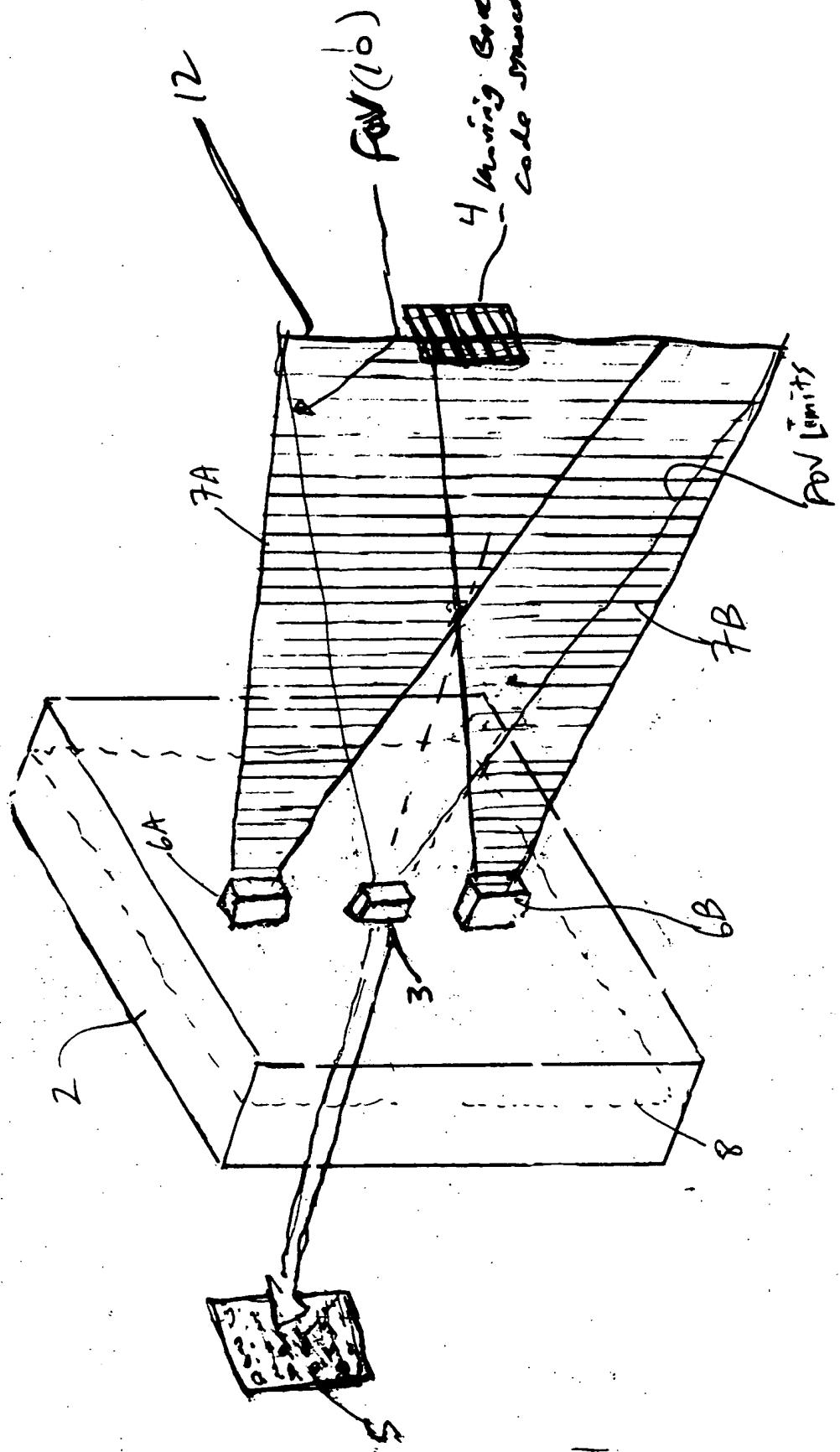
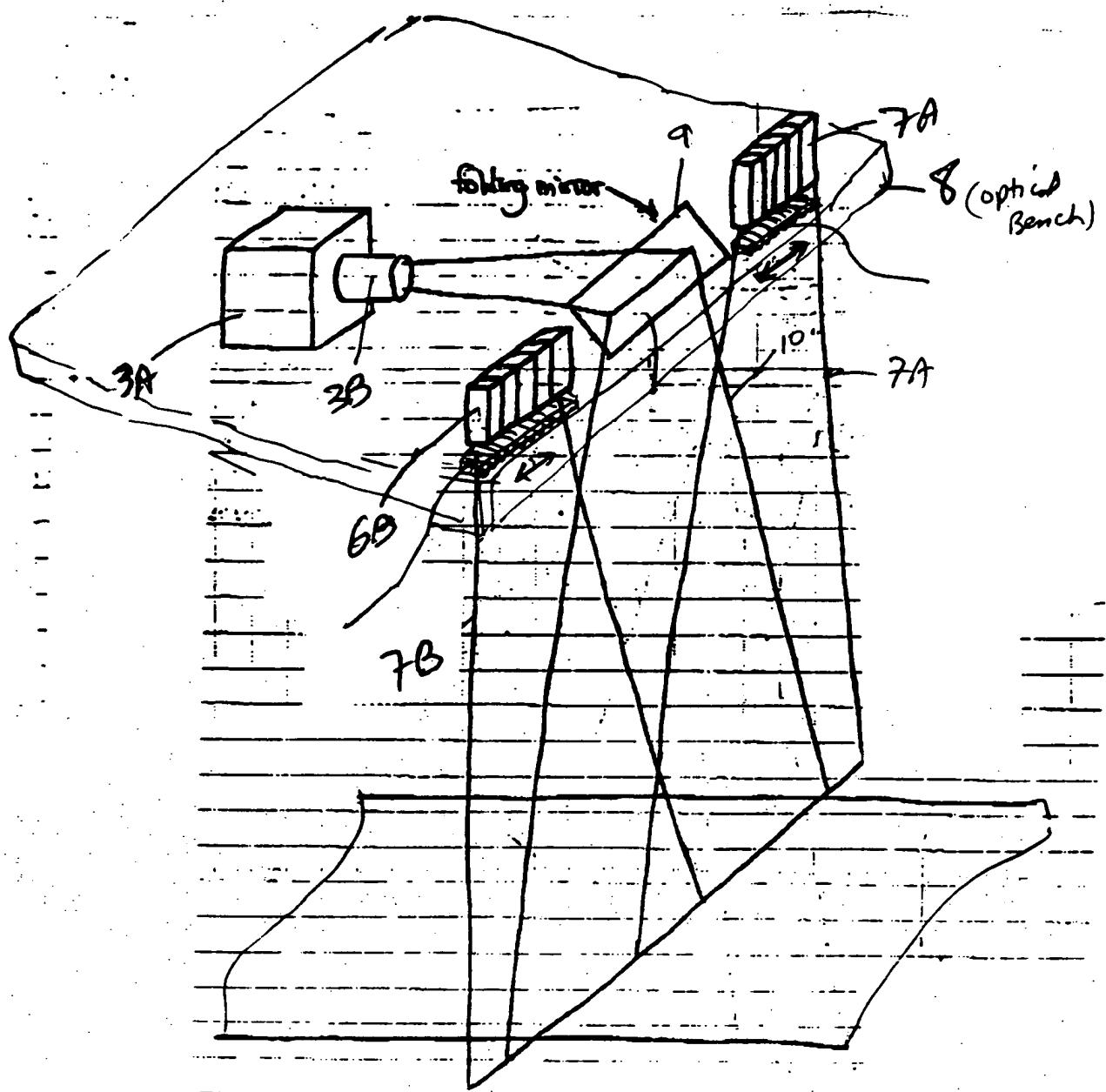


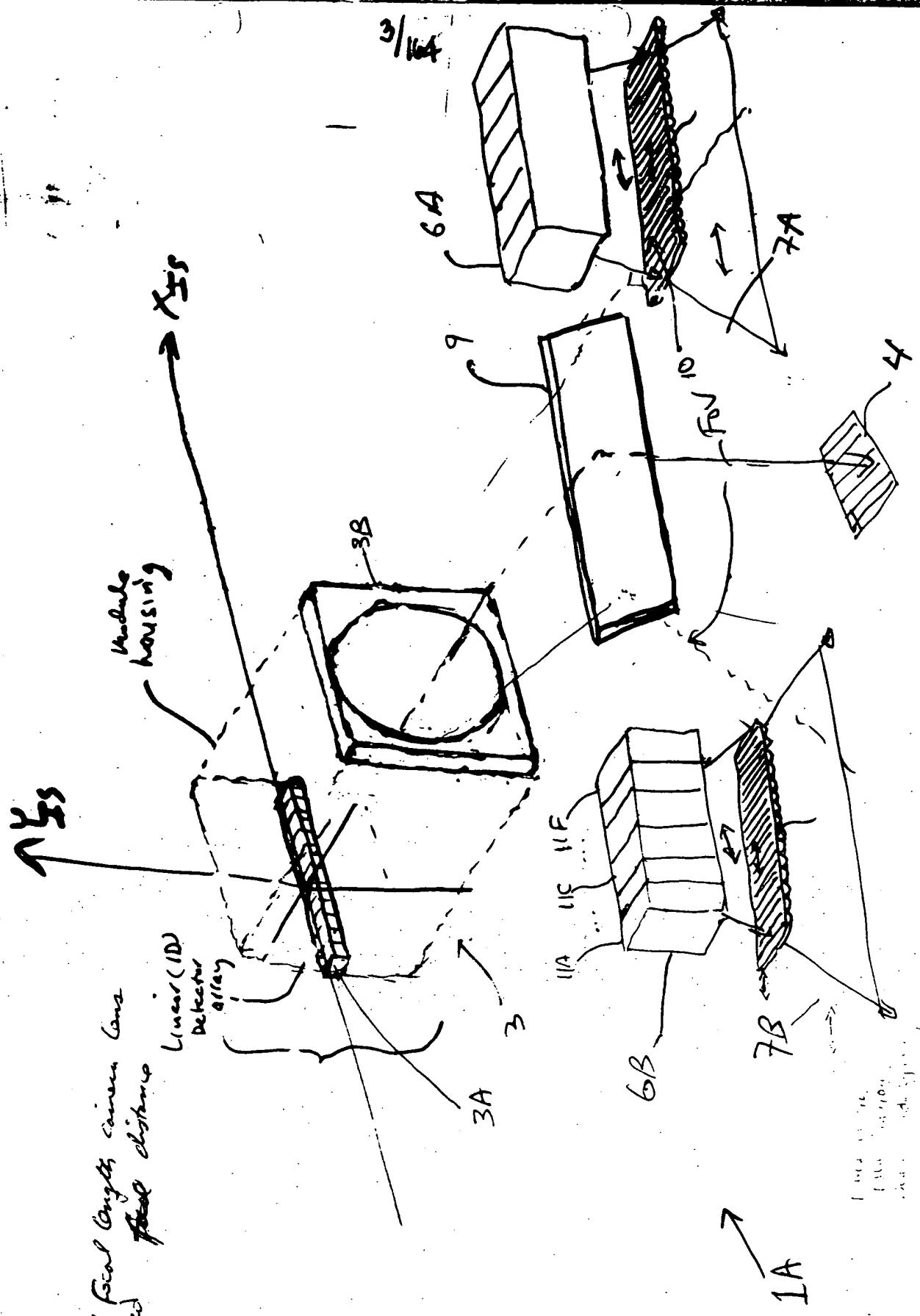
FIG: 1A

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1A

FIG 1B1



- (1) Fixed focal length camera lens
- (2) Fixed fixed distance

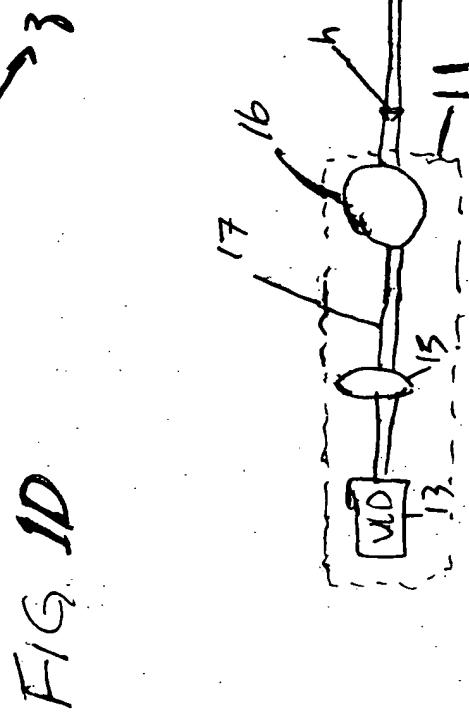
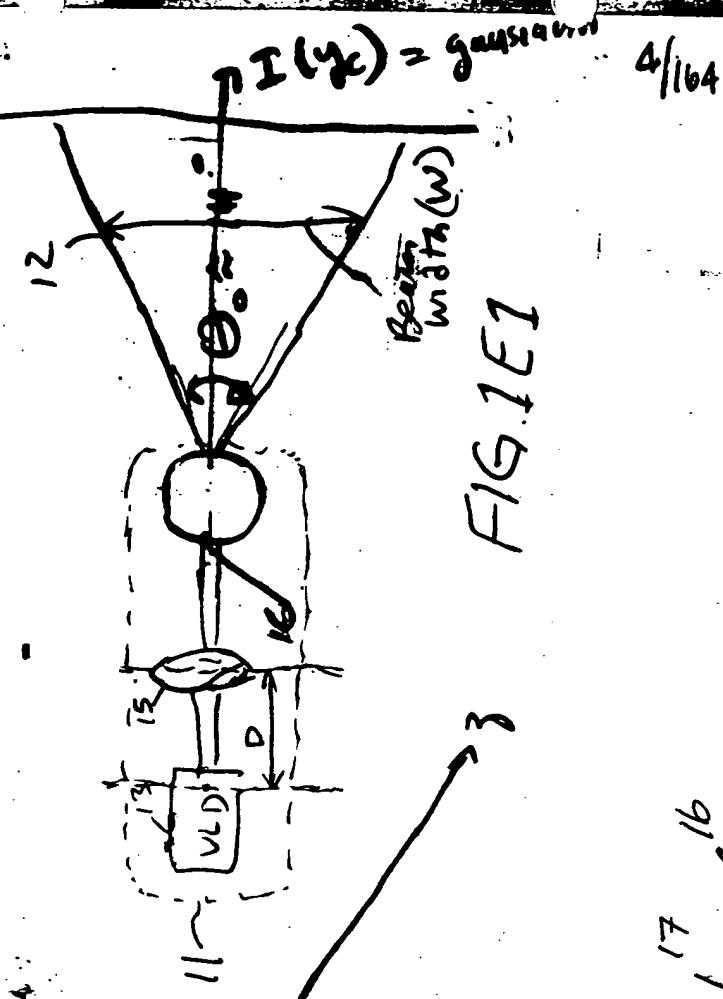
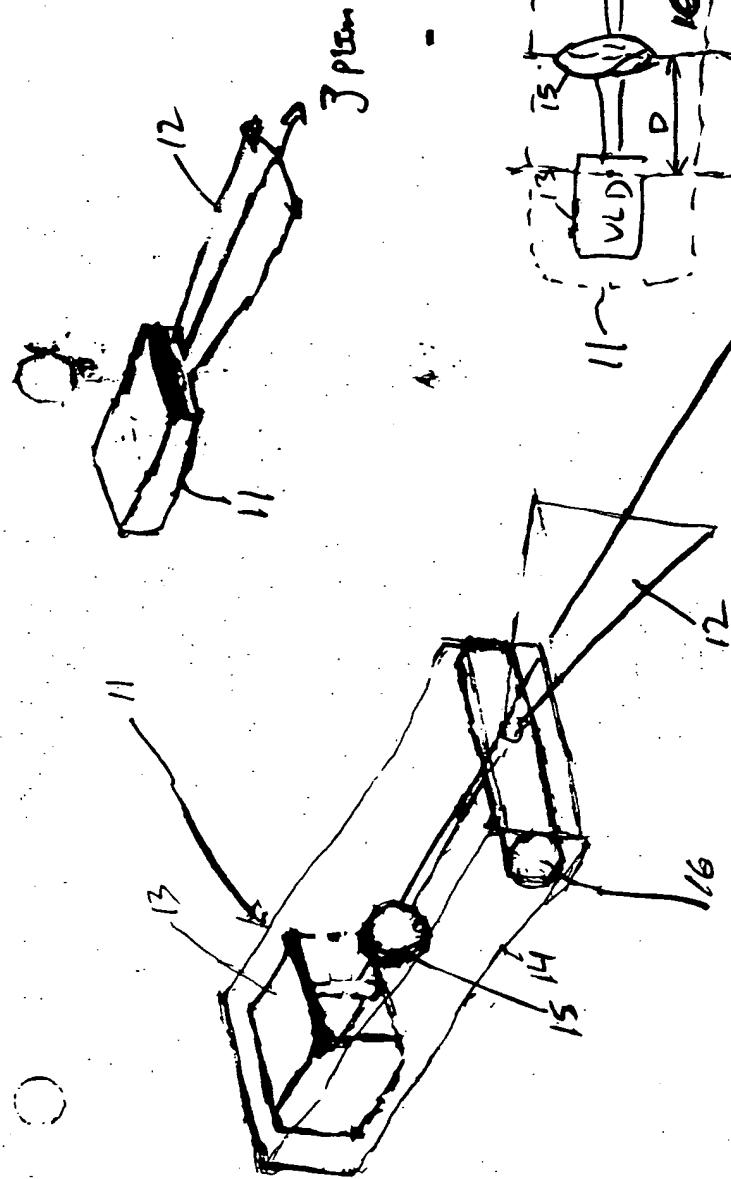


FIG. 1D

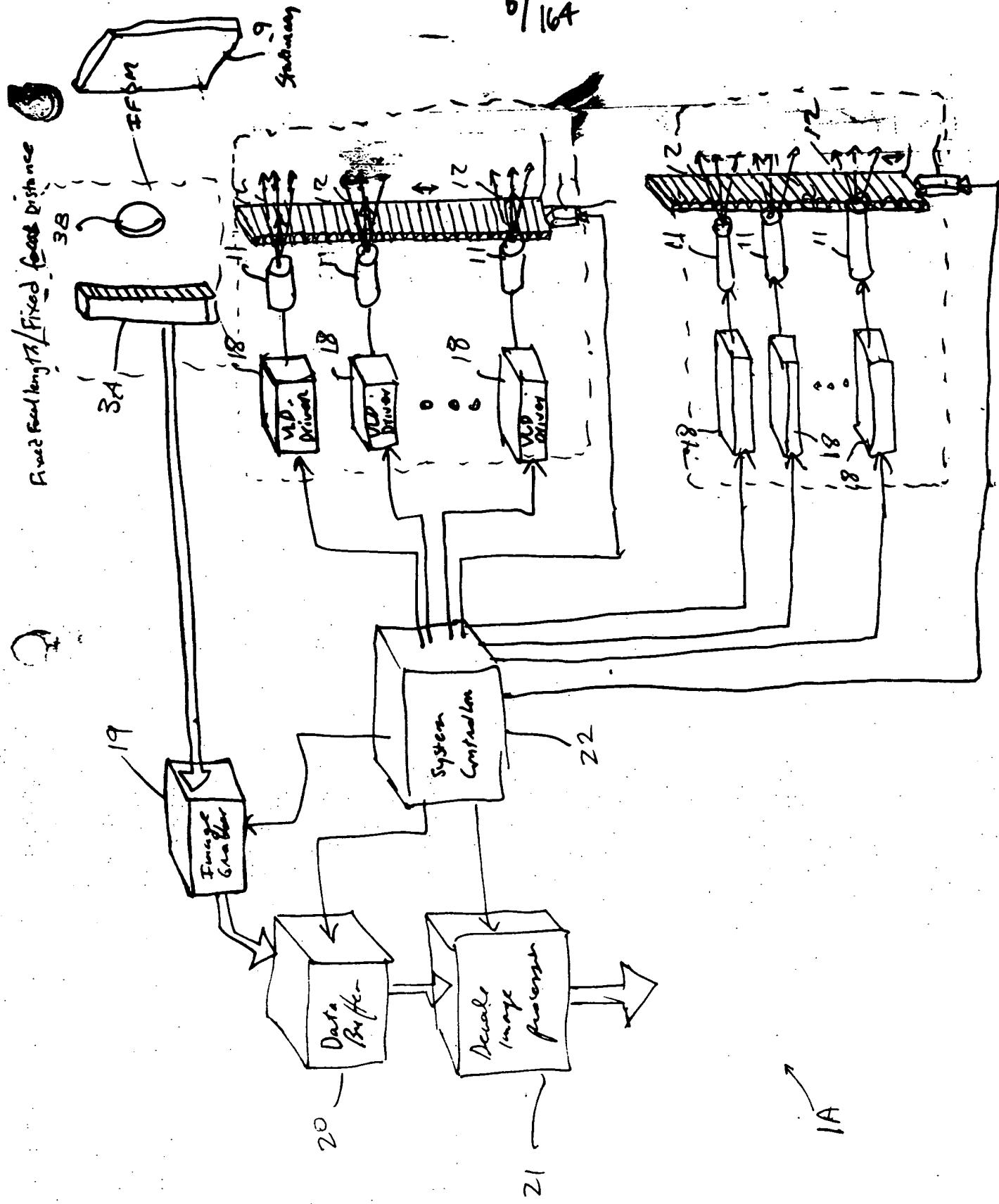


FIG. 1F

- 6/164

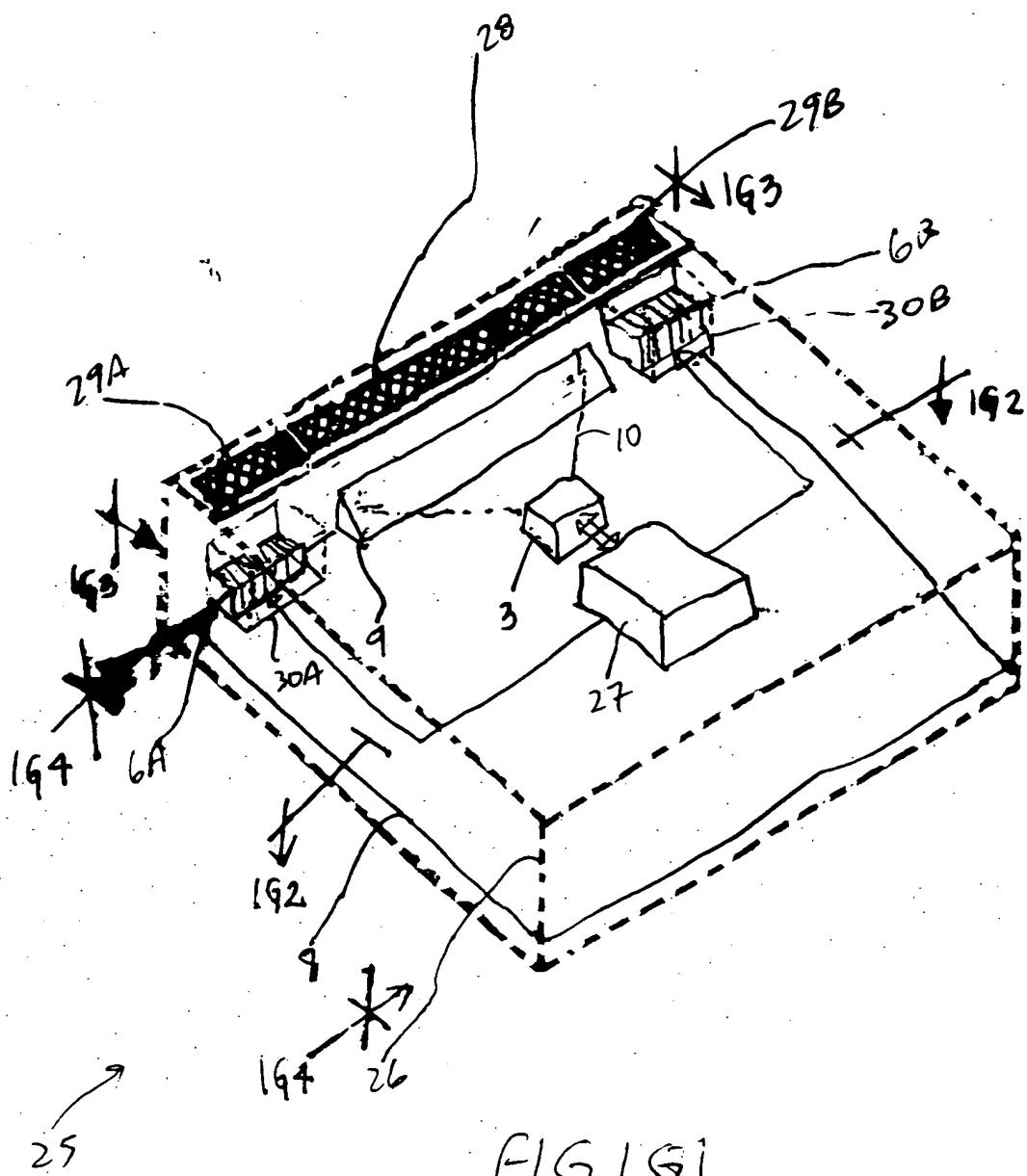


FIG 161

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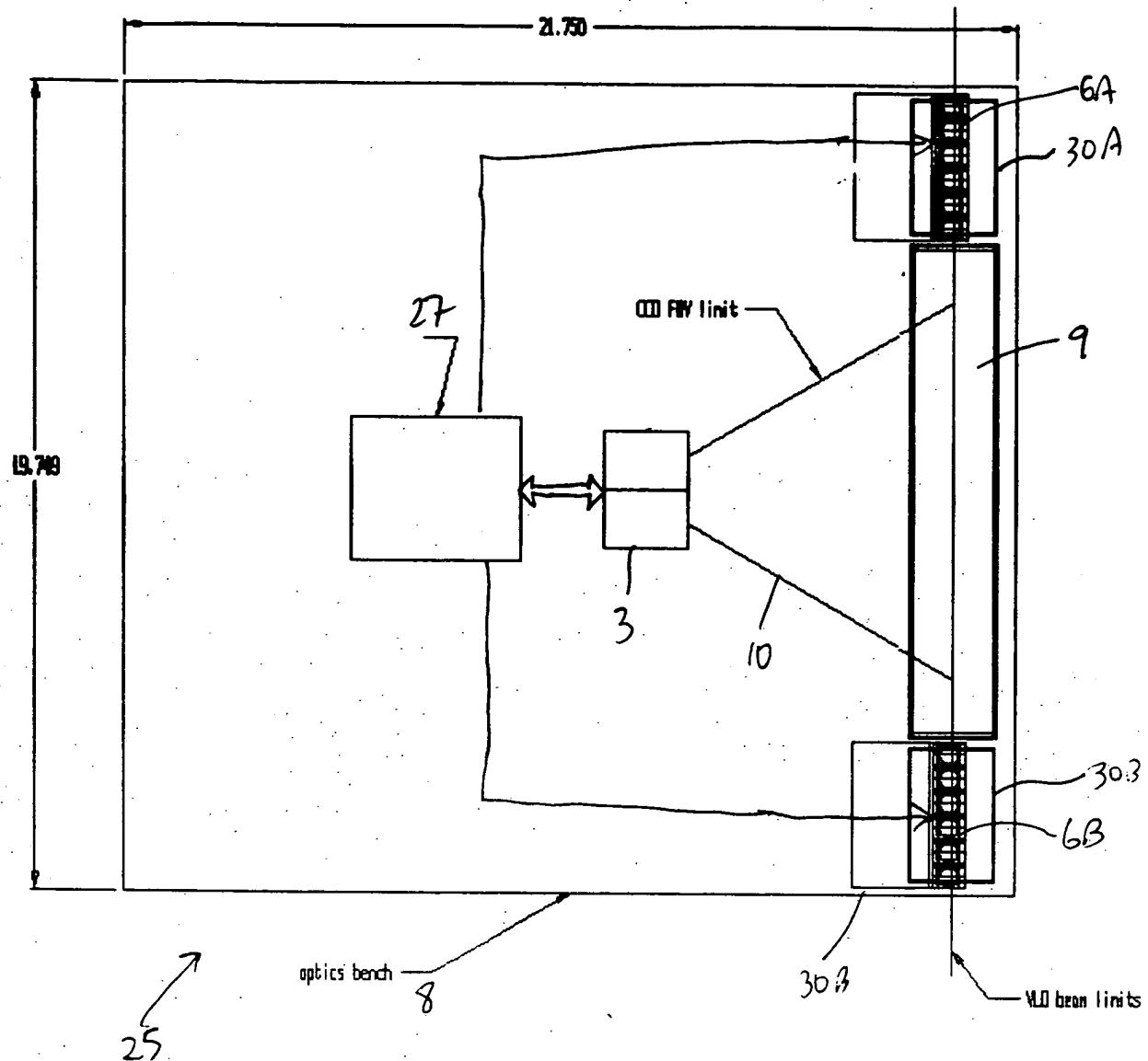


FIG. 1G2

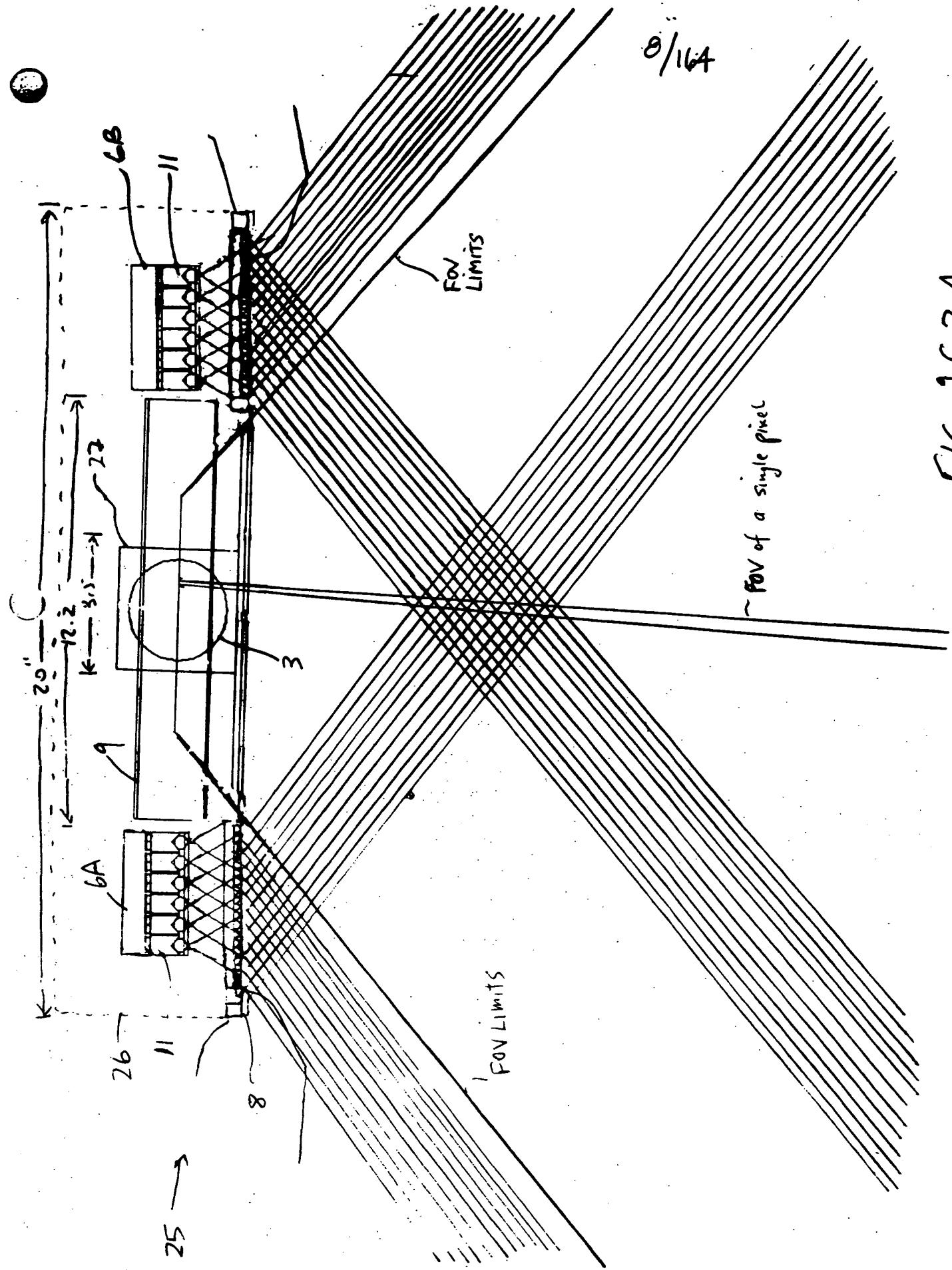


FIG. 1G3A

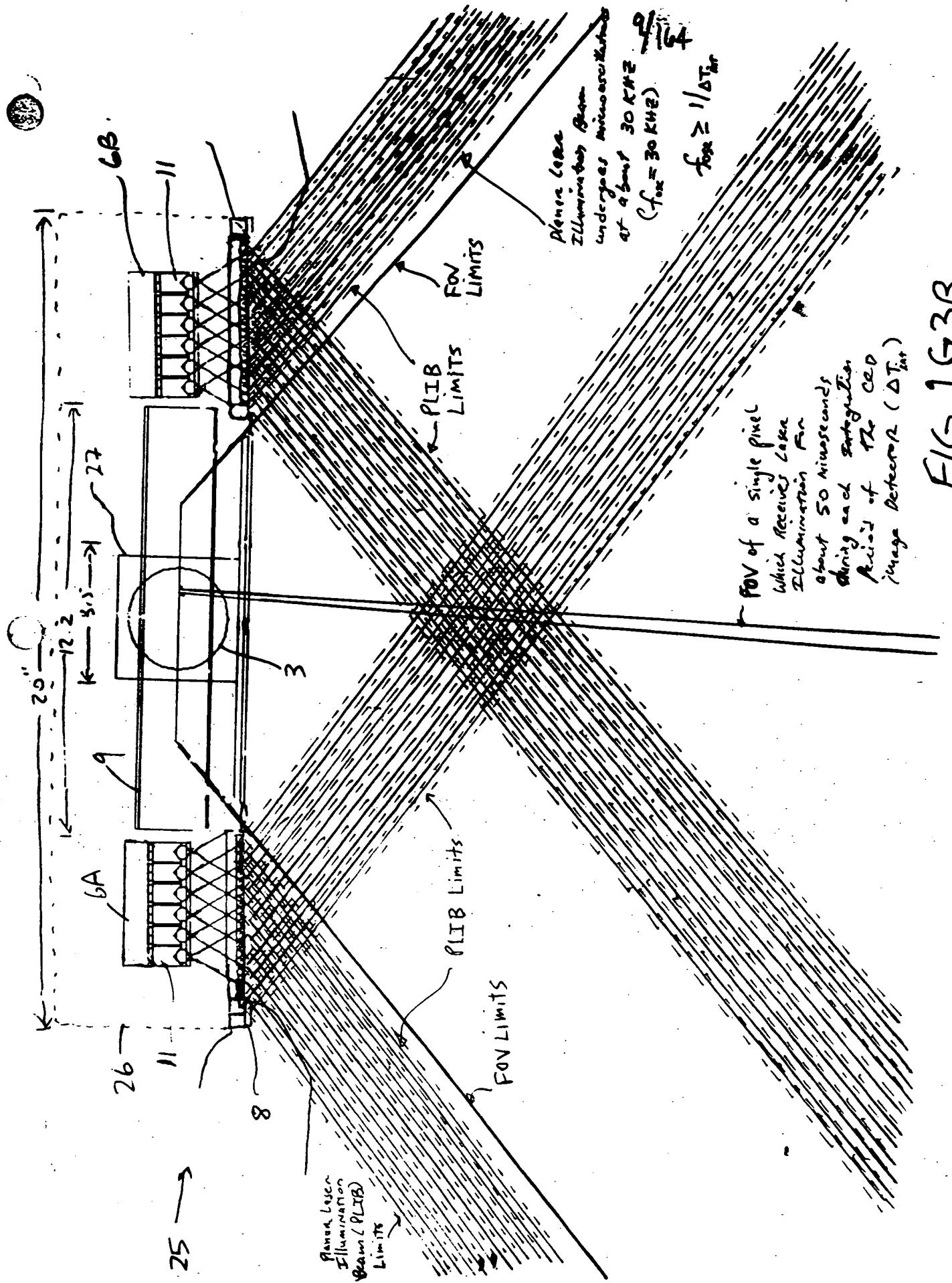


FIG 1G 3B

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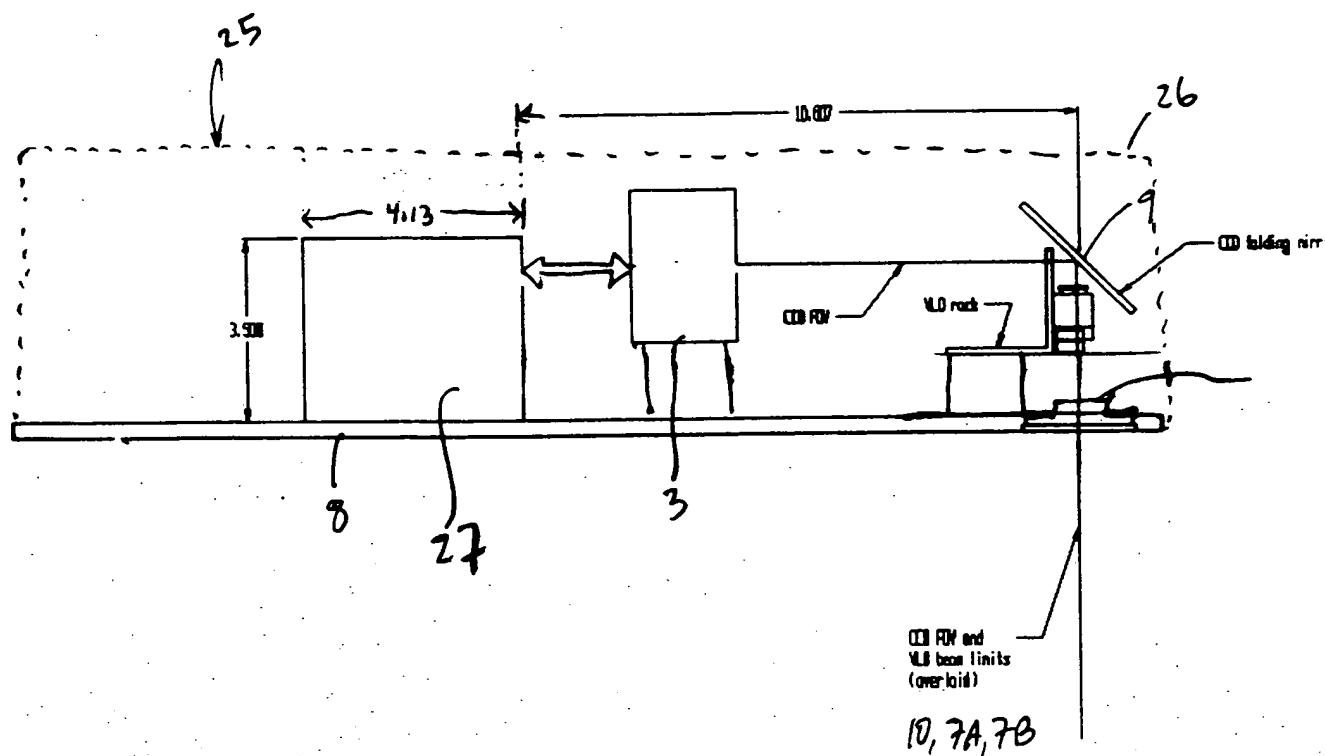
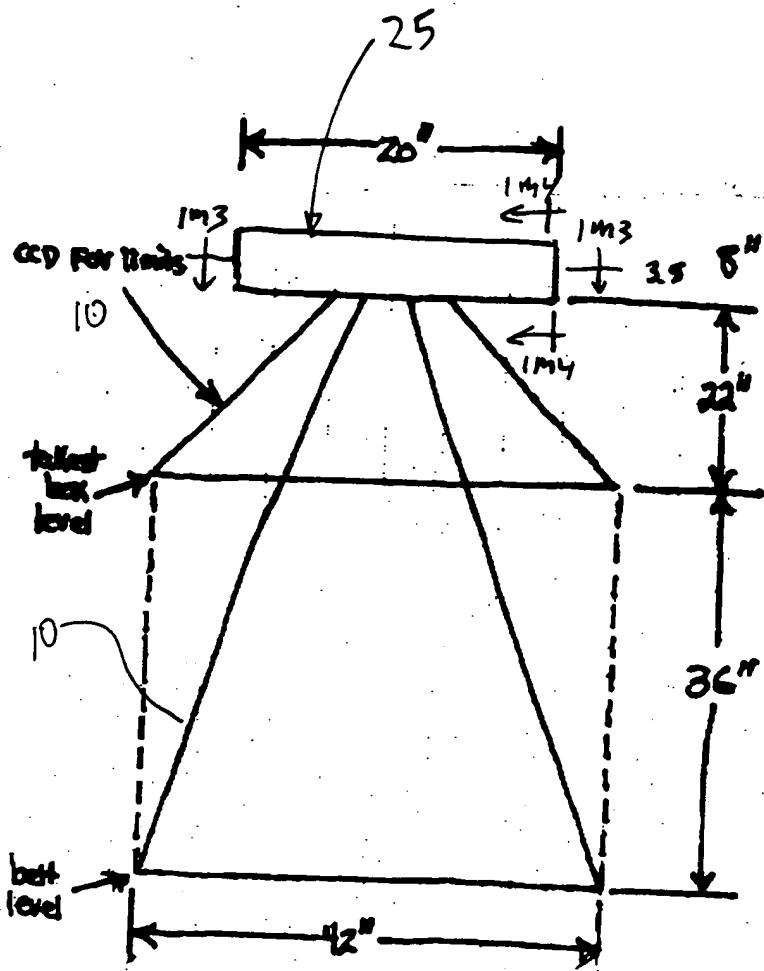


FIG. 164.

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* Fixed Field of Field

FIG. 1G5

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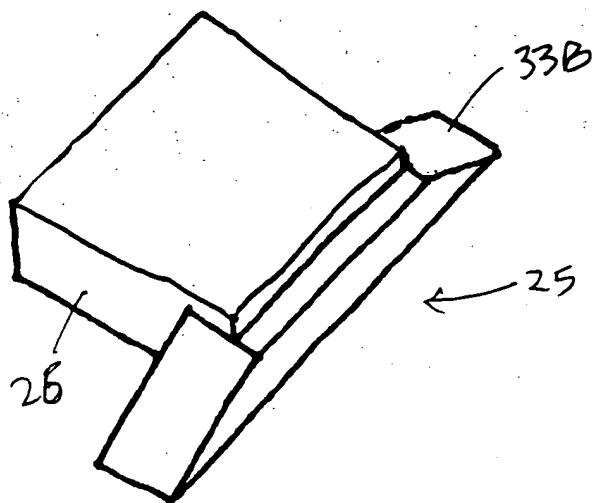
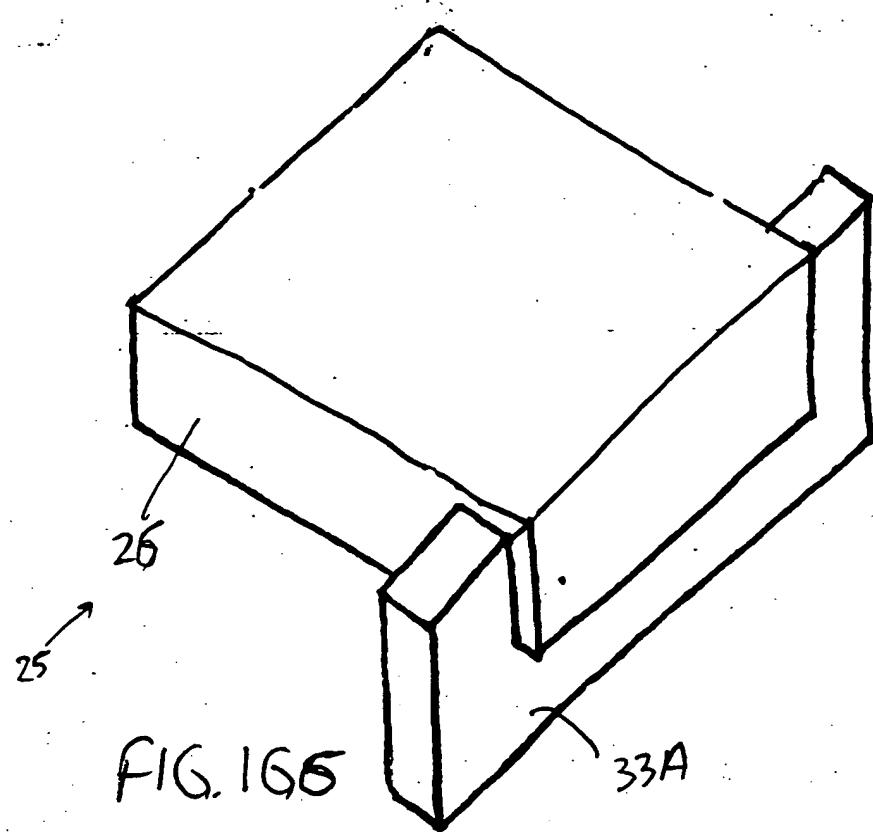
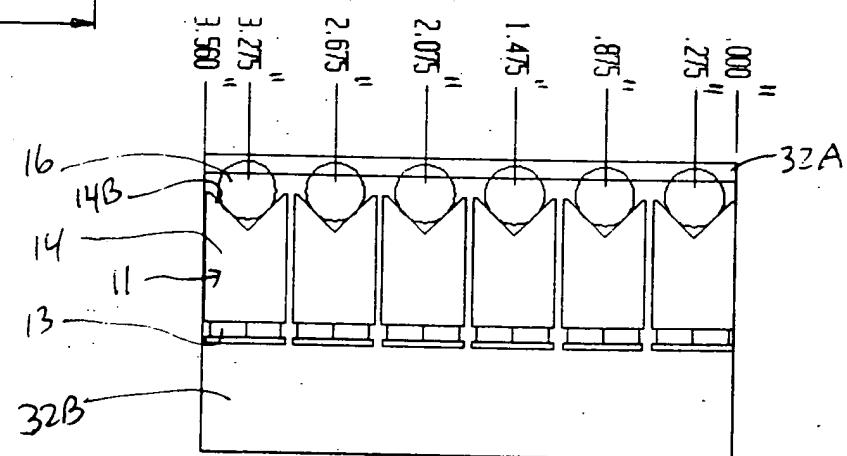
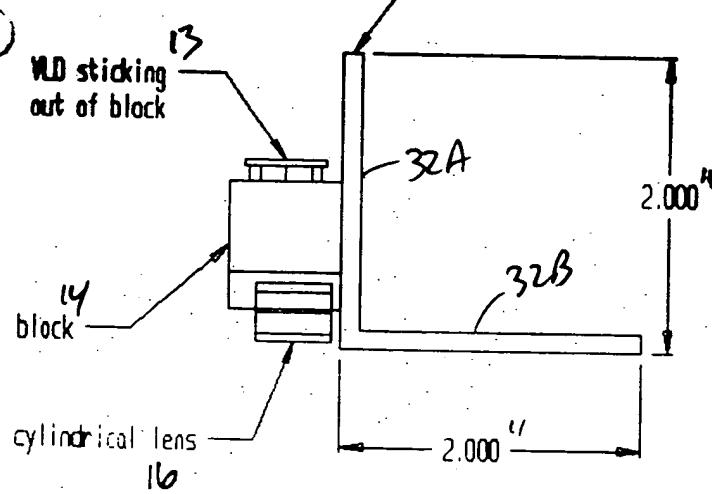
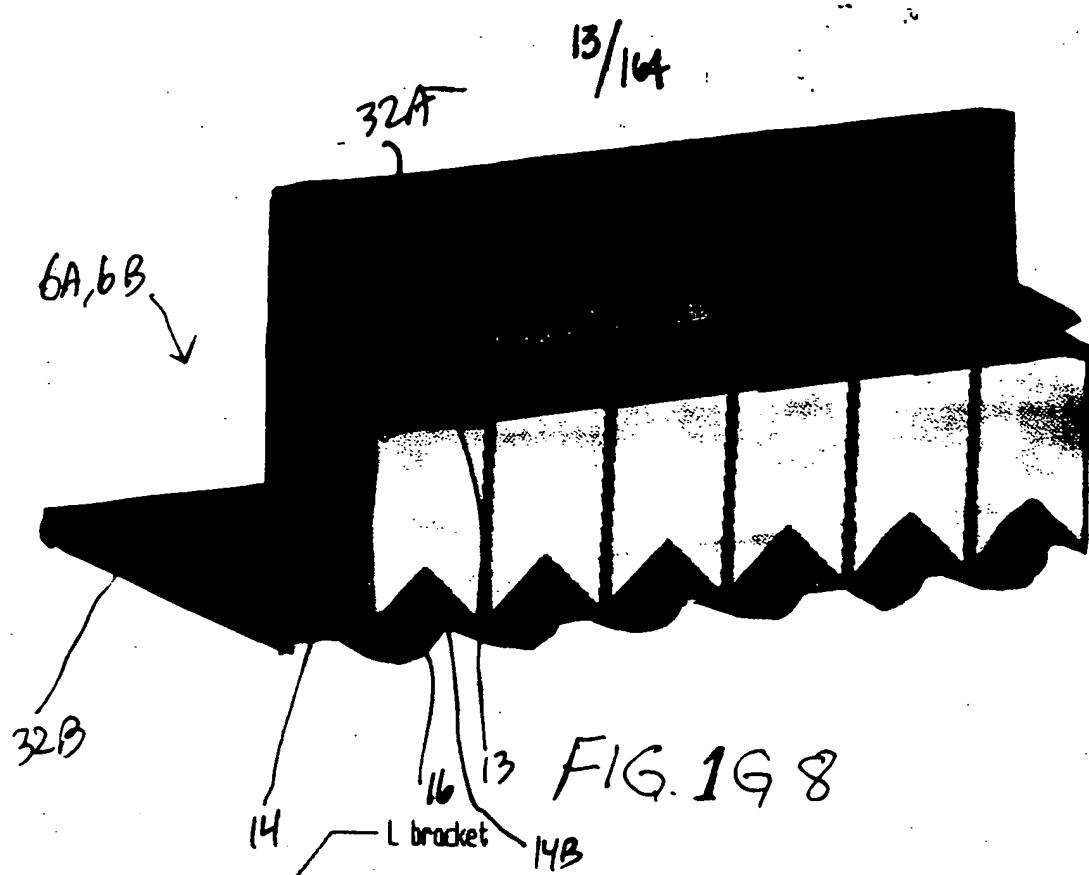


FIG. 1G7



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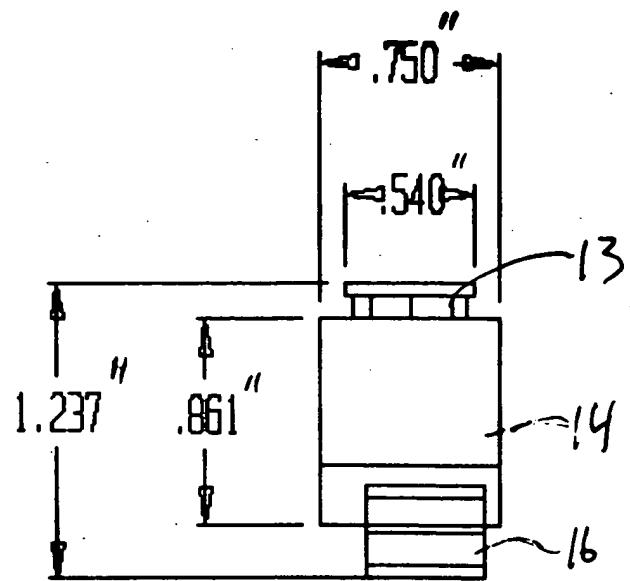


FIG. 1G11

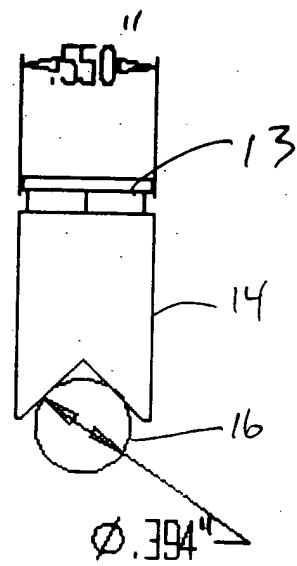


FIG. 1G12

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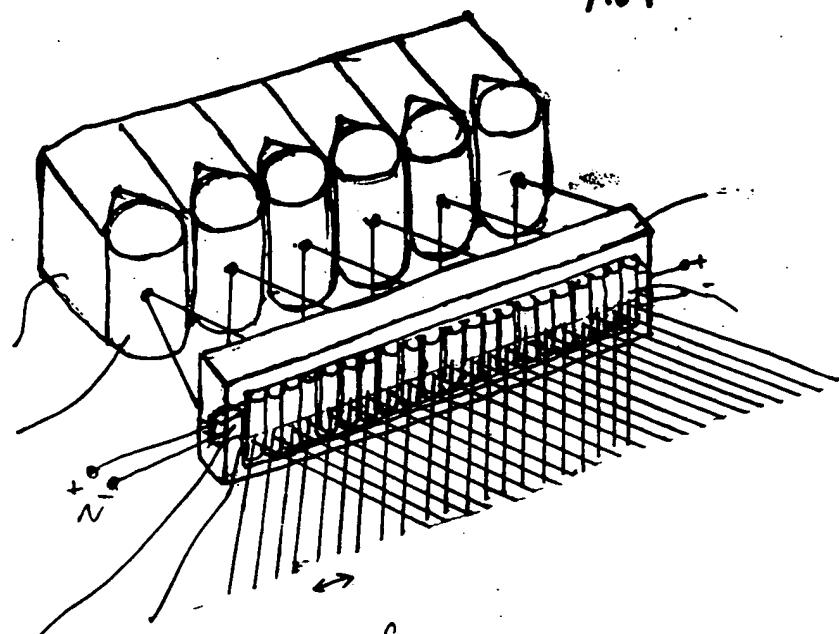


FIG. 1G13

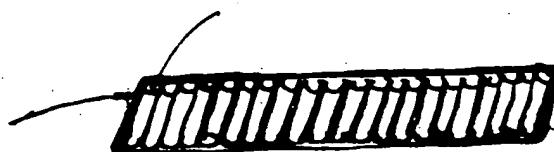


FIG. 1G14



FIG. 1G15

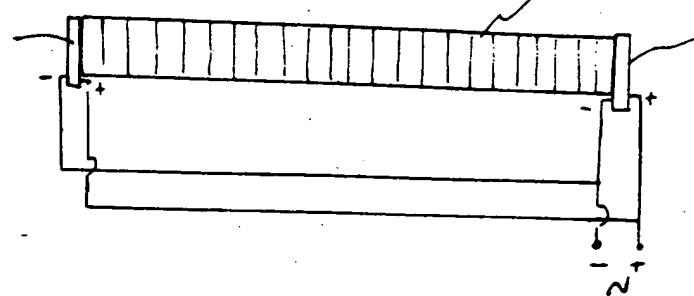


FIG. 1G16

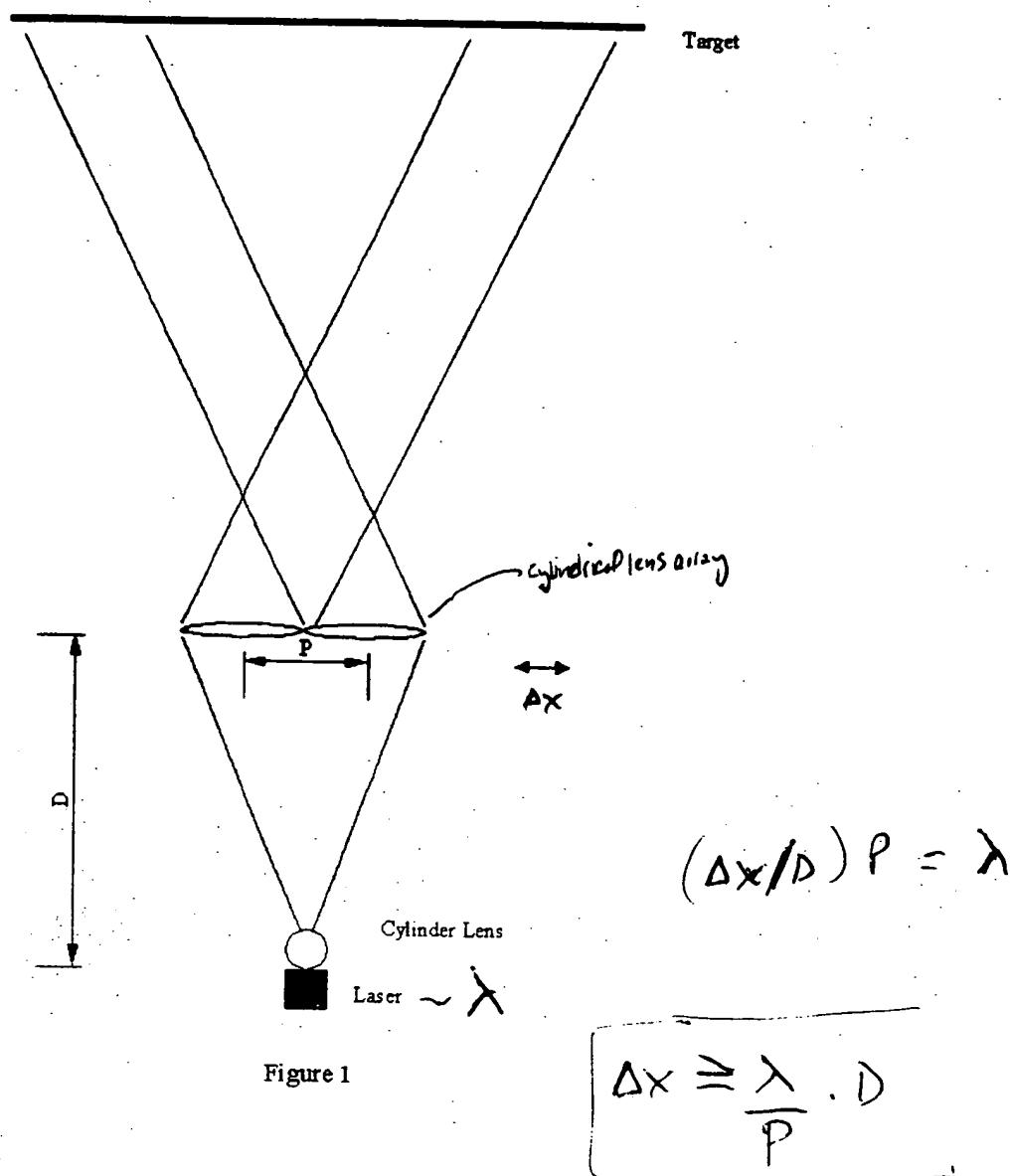


FIG. 1G13A

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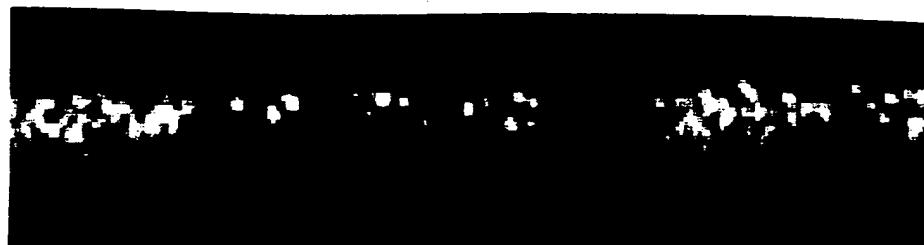


FIG. 1G13B1



FIG. 1G13B2

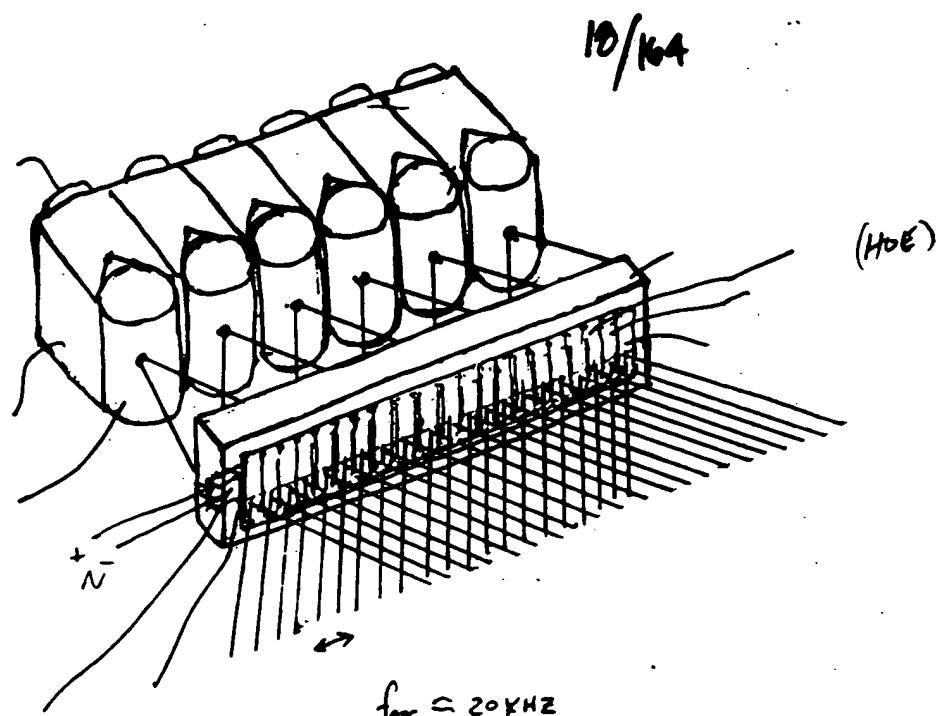


FIG 1G17

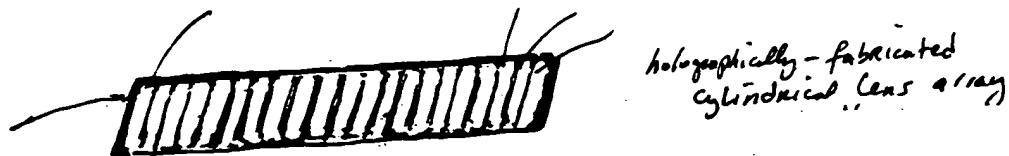


FIG. 1G18

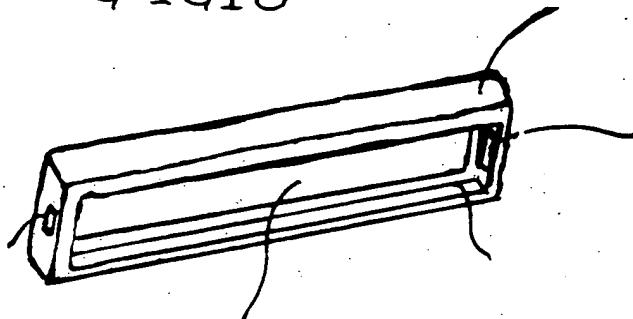


FIG 1G.19

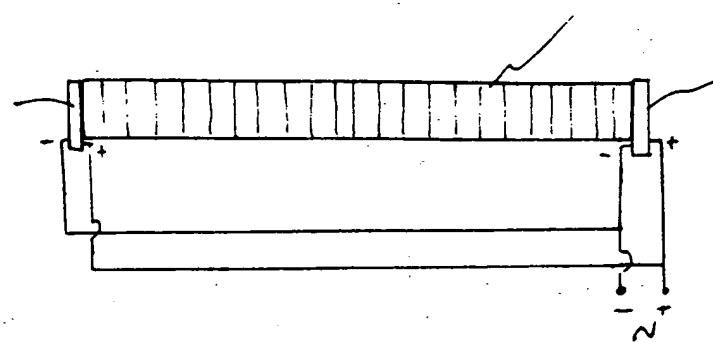


FIG. 1G20

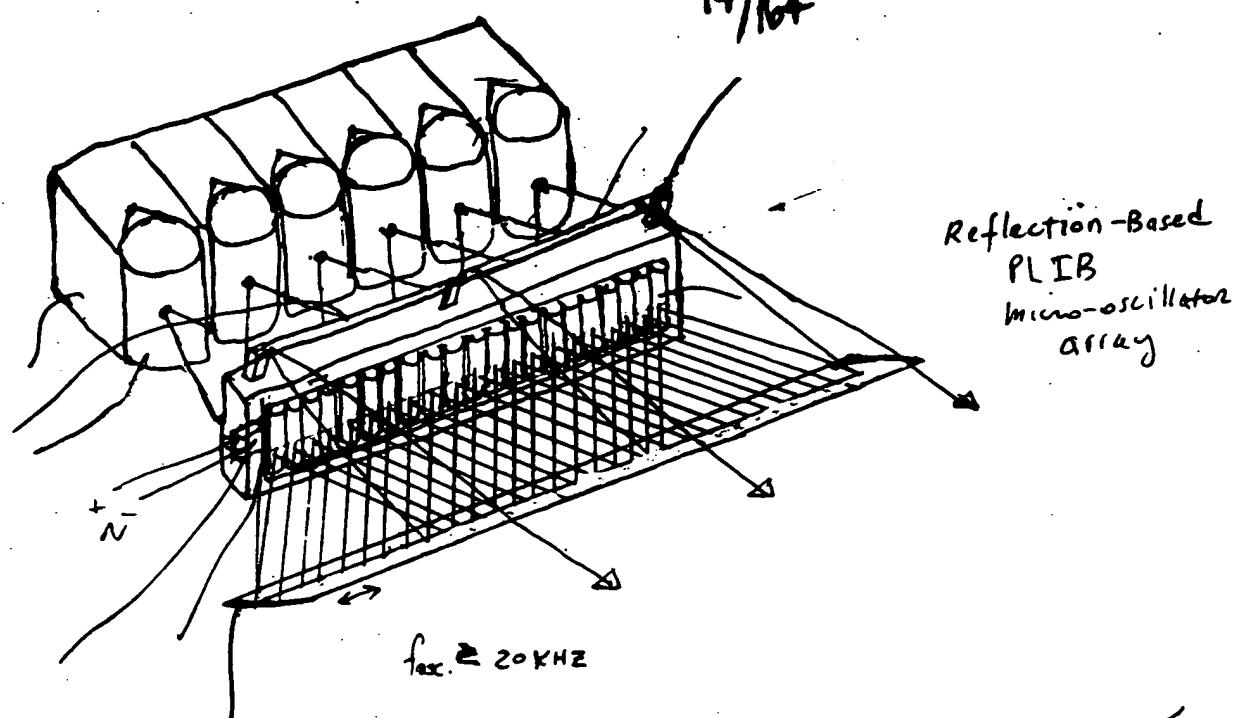


FIG.1G21

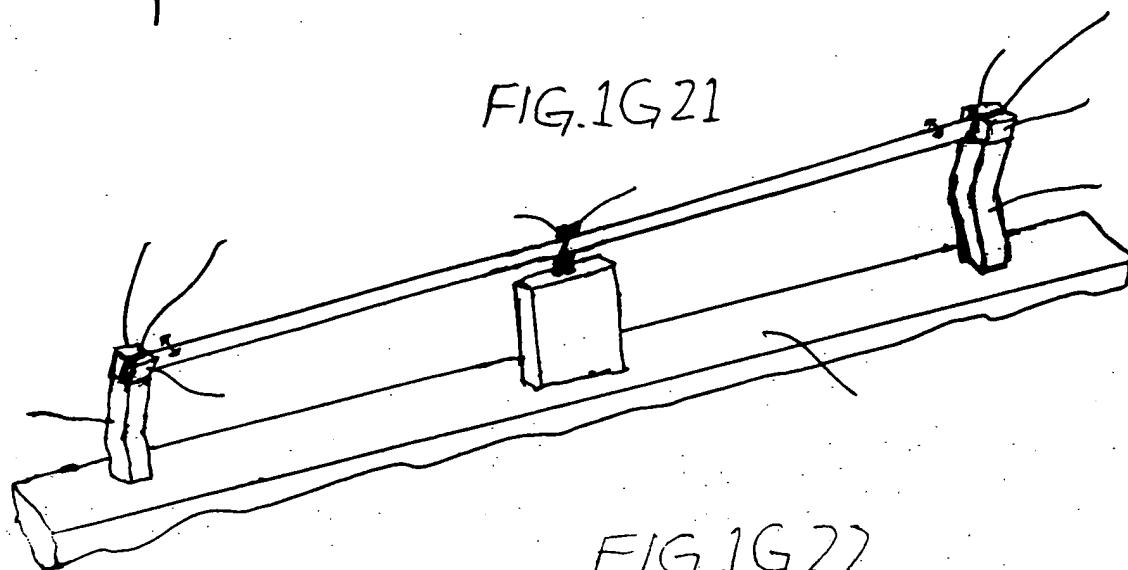


FIG.1G22

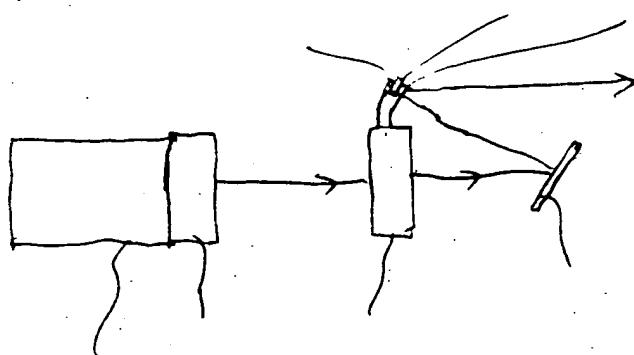


FIG.1G23

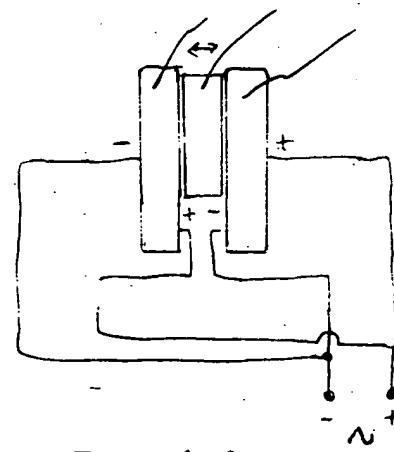


FIG.1G24

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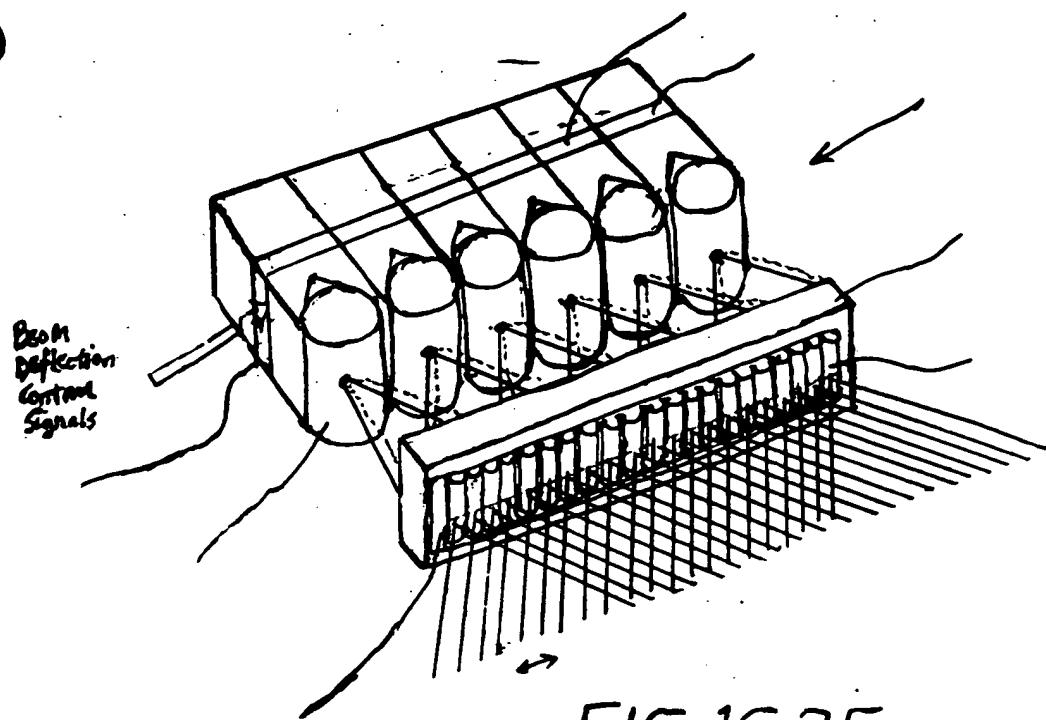


FIG.1G25

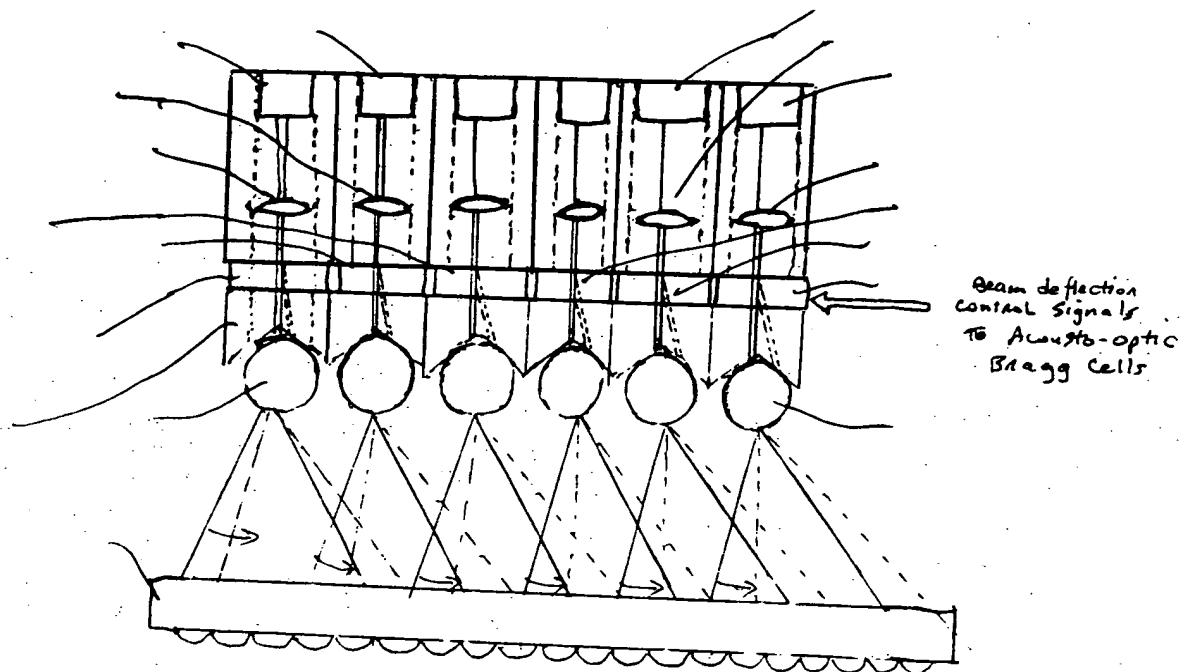


FIG.1G26

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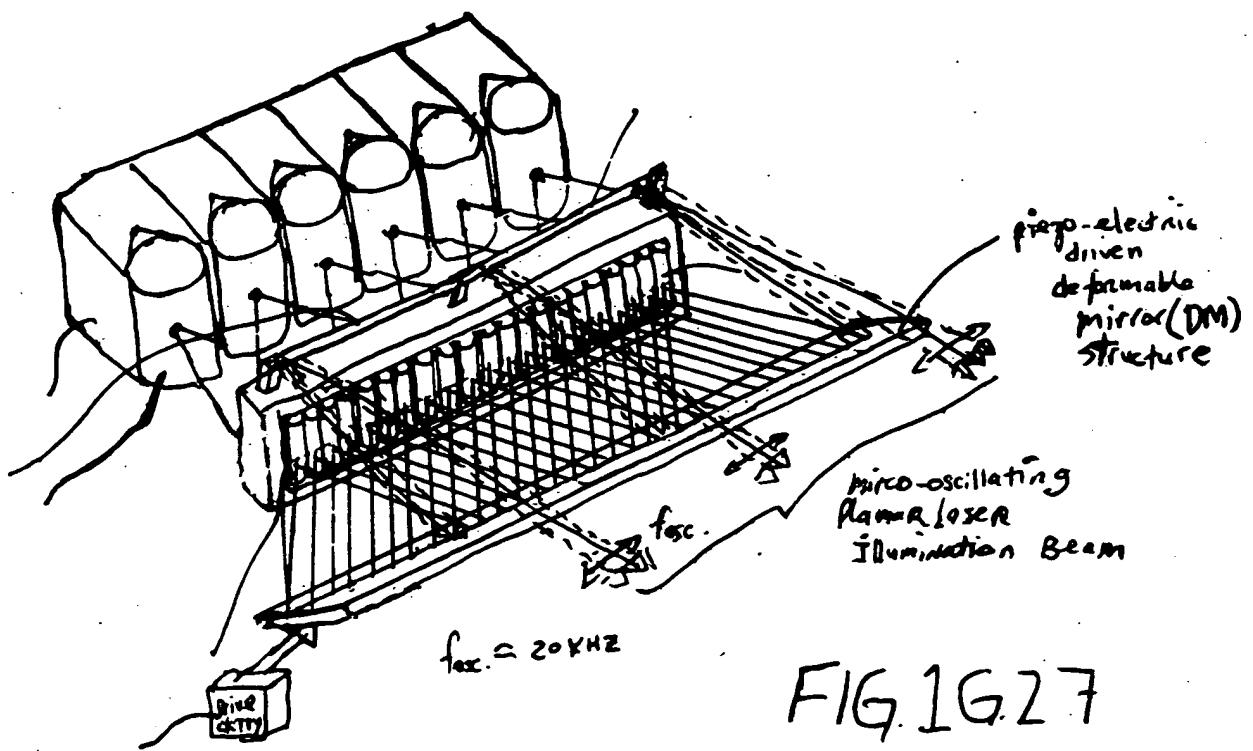


FIG.1G27

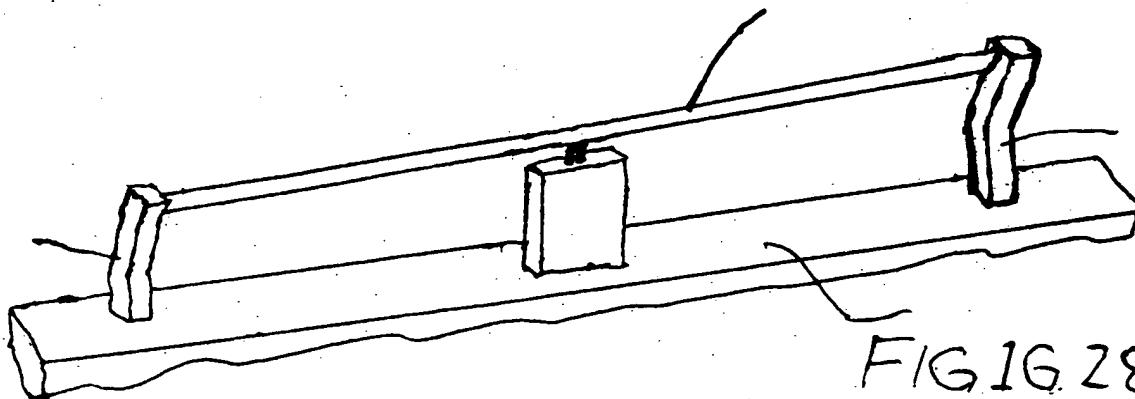


FIG.1G28

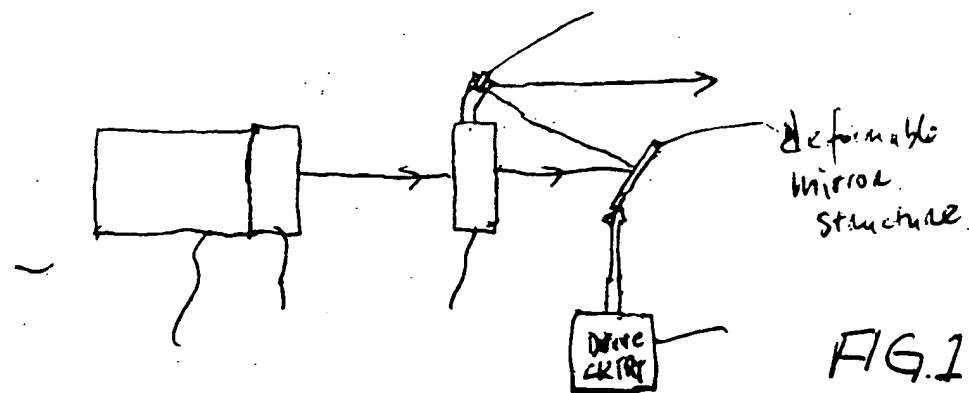


FIG.1G29

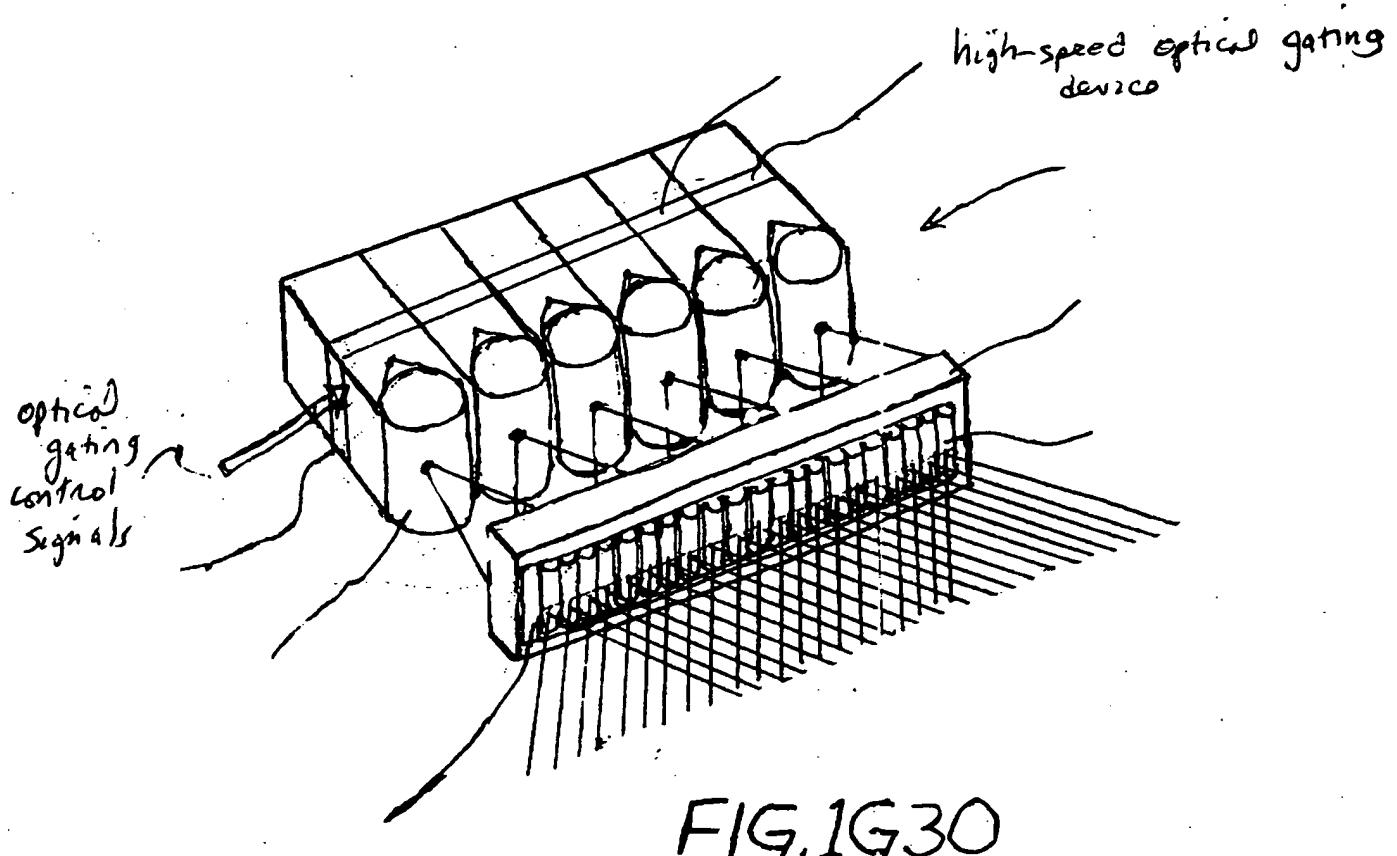


FIG. 1G30

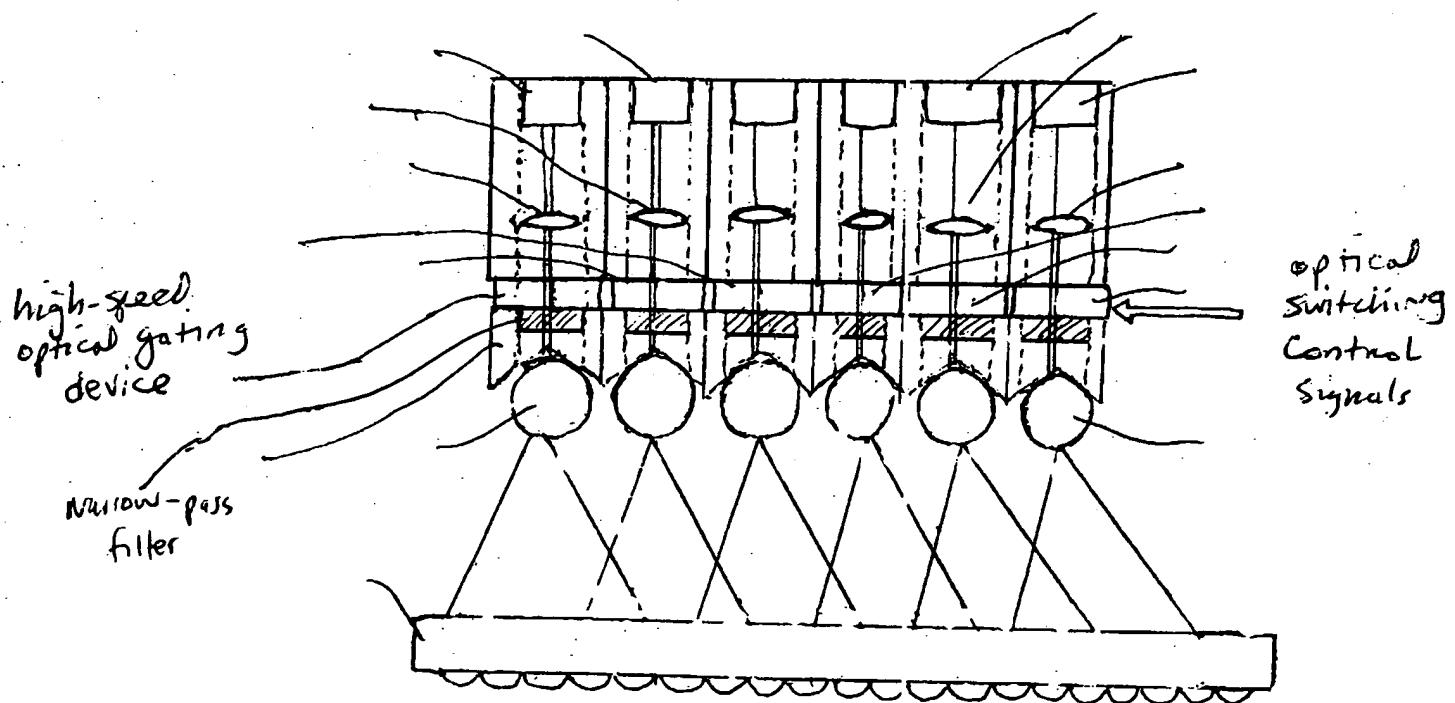


FIG. 1G31

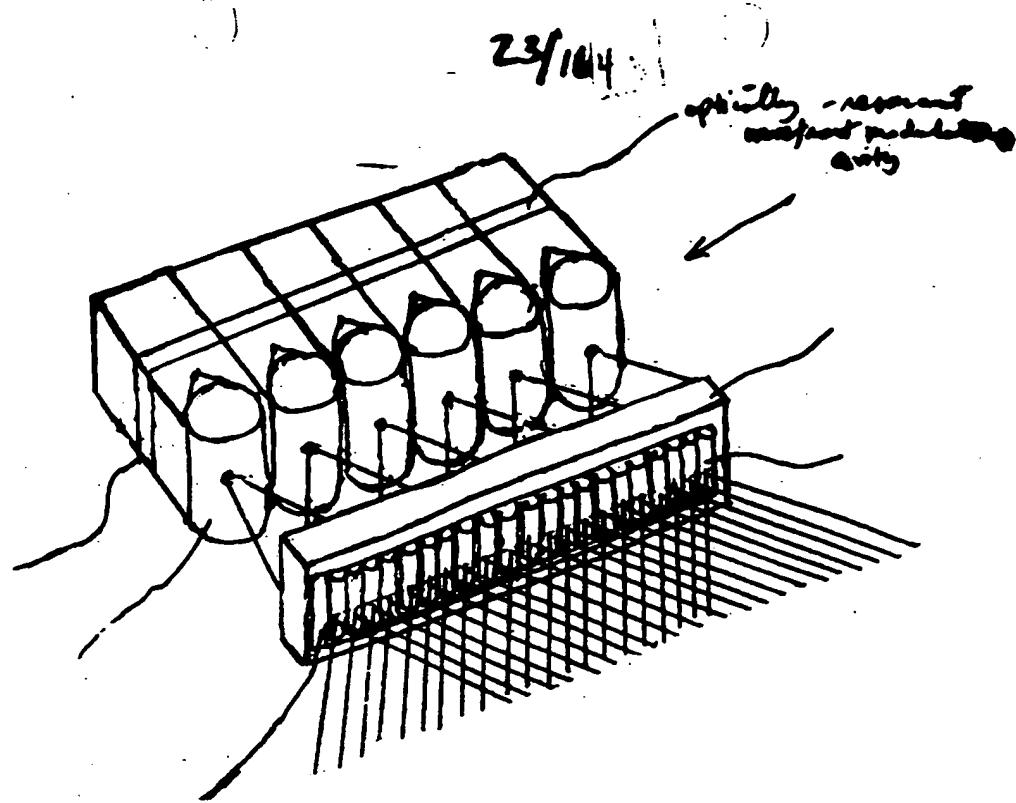


FIG 1G32

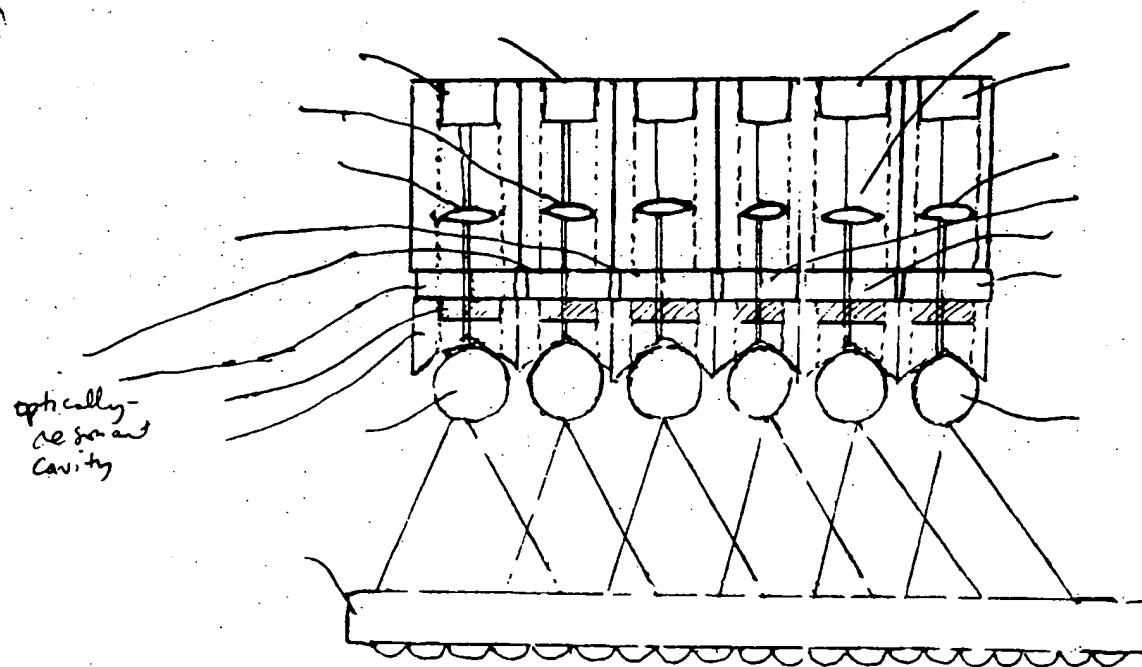


FIG 1G33

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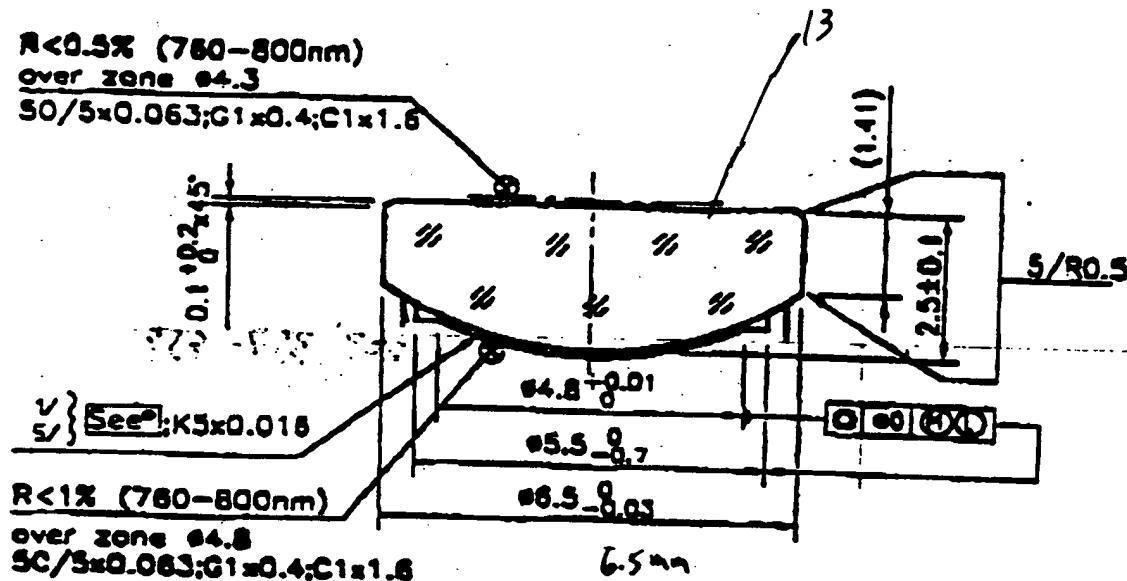


FIG. 1H1

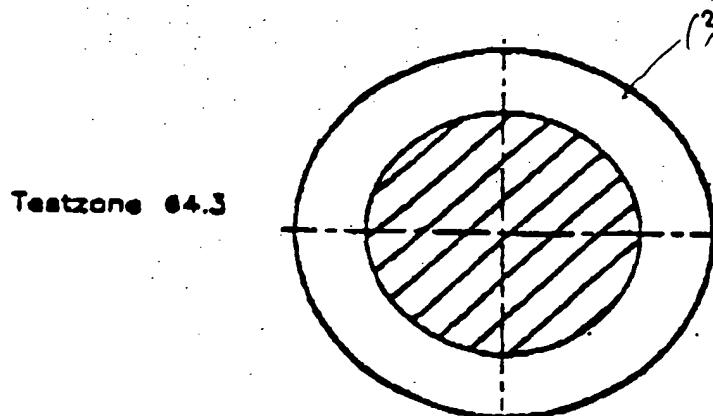


FIG. 1H2

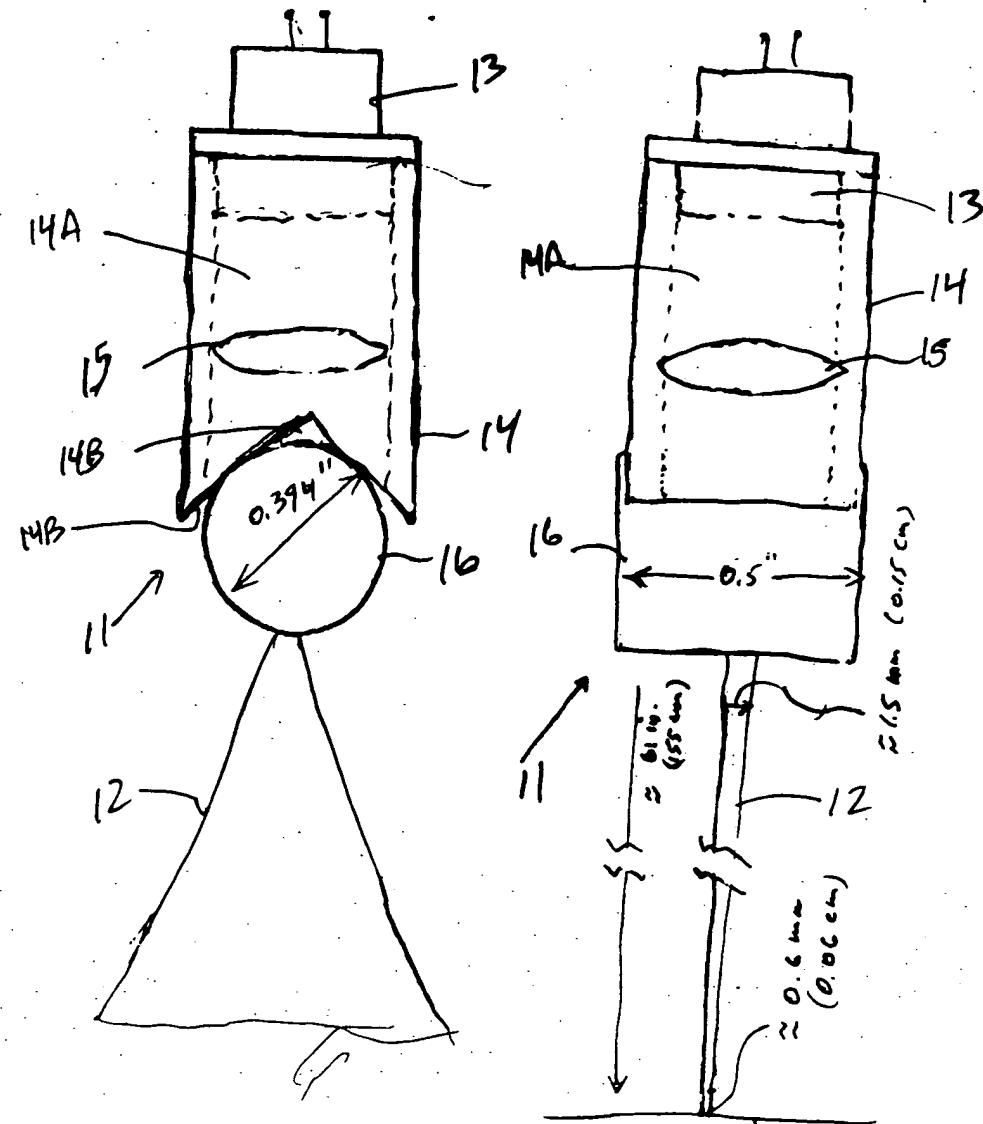


FIG. III1

FIG. III2
furthest
object/working
distance

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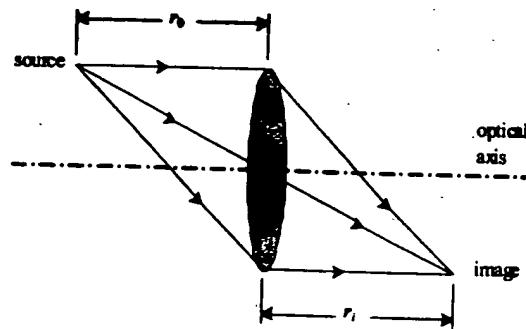


FIG. 1J1

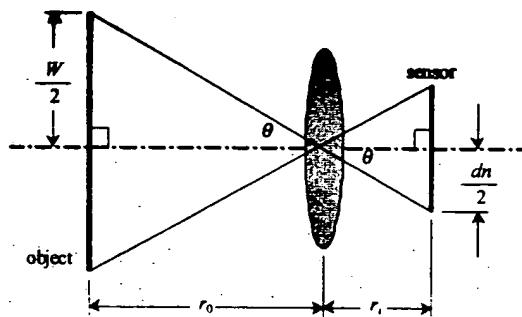


FIG. 1J2

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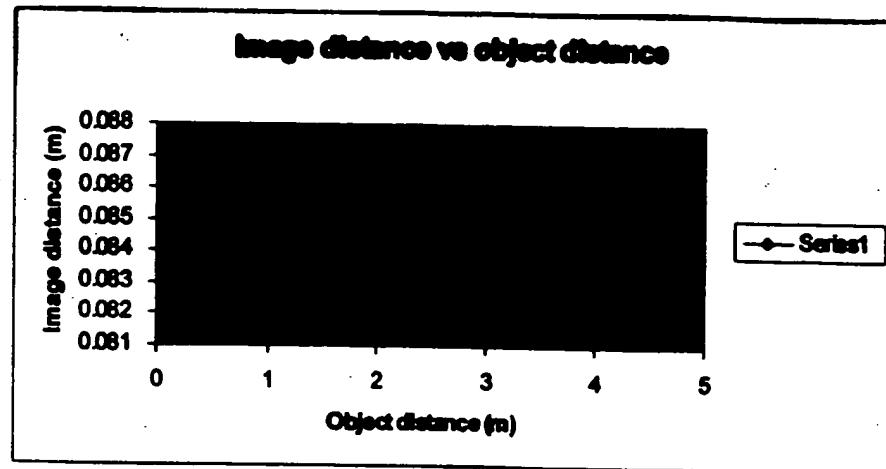


FIG. 1J3

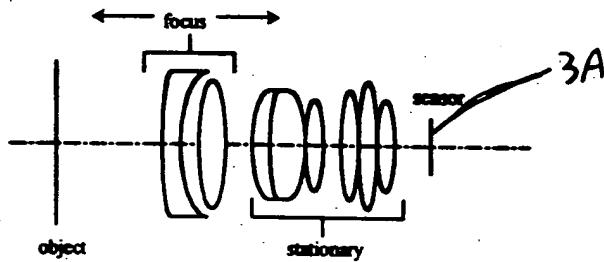


FIG. 1J4

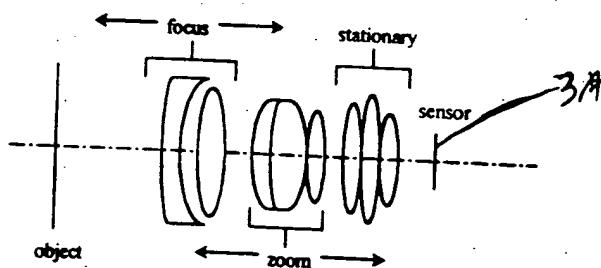
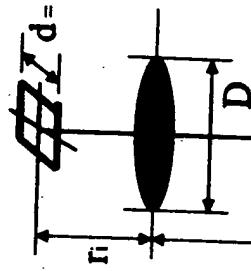


FIG. 1J5

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$E_{CCD} = \text{CCD irradiance}$
(in Watts / meter squared)



f = Lens Focal Length
 F = Lens f-stop
 r_i = Image distance
 r_o = Working distance
 m = Lens Magnification

Assumptions:
1) Objects are Lambertian Scatterers
2) Object Reflectance = 100%
3) Optical Transmittance = 100%
4) Square CCD pixels

$E_{Obj.} = \text{Evenly distributed irradiance}$
(in Watts / meter squared)

A schematic diagram of a CCD-based scanner. An object of diameter D_o is located at a distance r_o from a lens. The lens forms an image of diameter D_o at the image plane. A CCD pixel, represented by a rectangle of width d_o , is shown at the image plane. The text $d_o = \text{dimension of CCD Pixel projected onto the object plane}$ is written next to the pixel.

CCD-Based Scanner

FIG. 1 J 6

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fixed focal length lens
cases

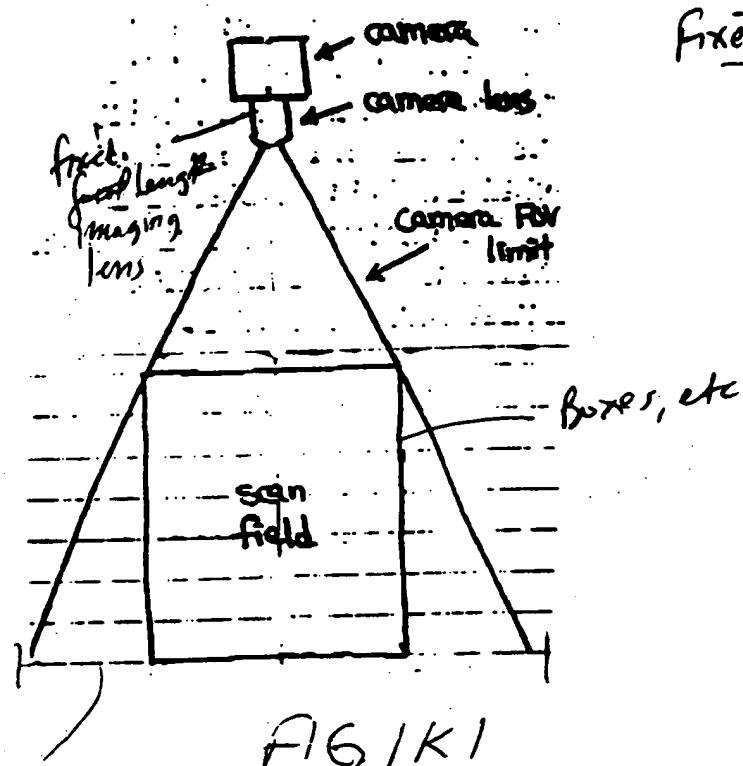


FIG 1K1

Conveyor 34

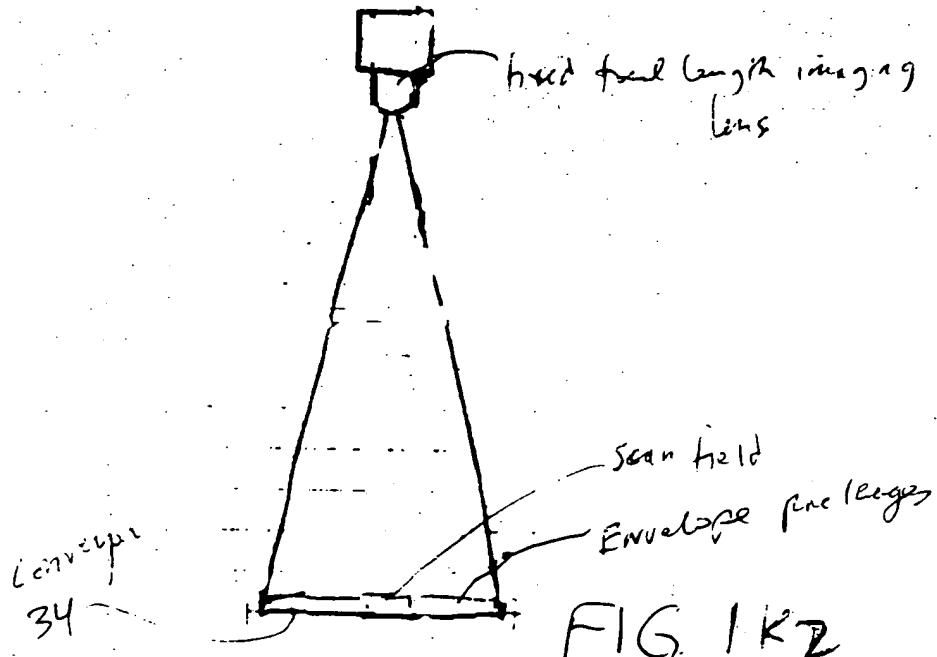


FIG. 1K2

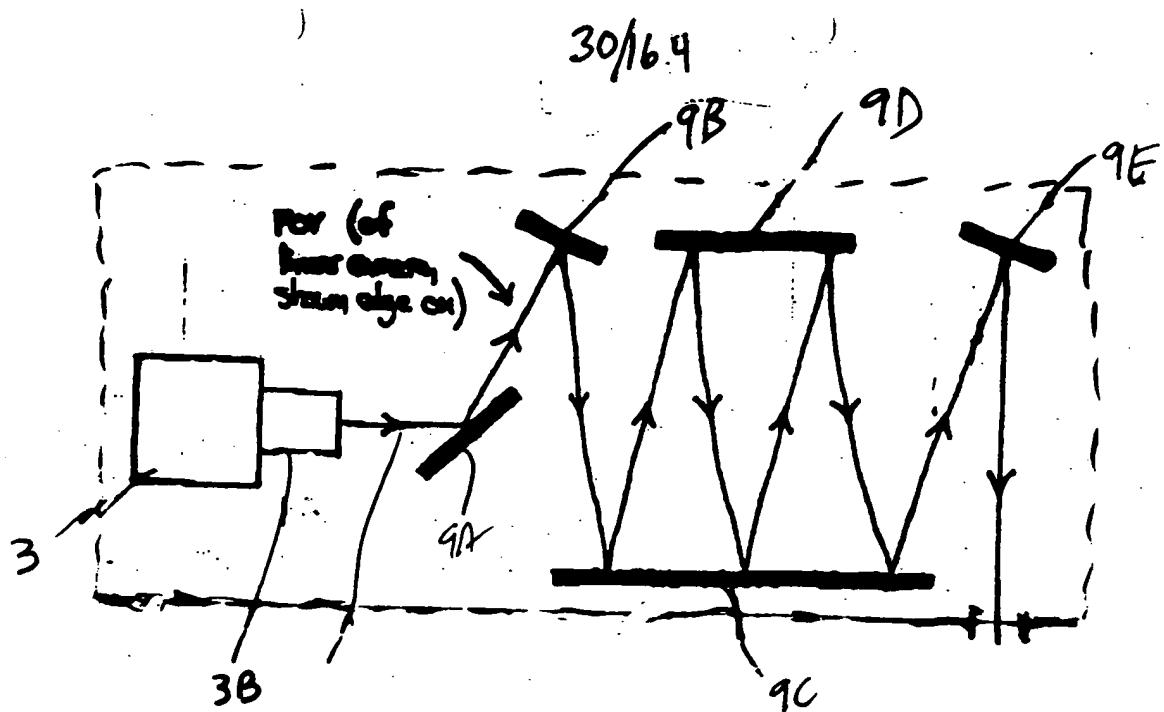


FIG. 1L1

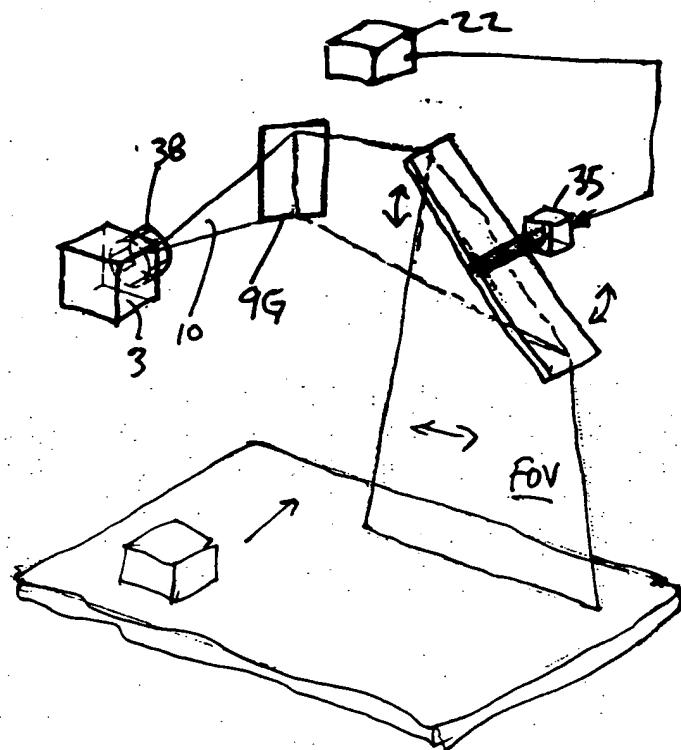


FIG. 1L2

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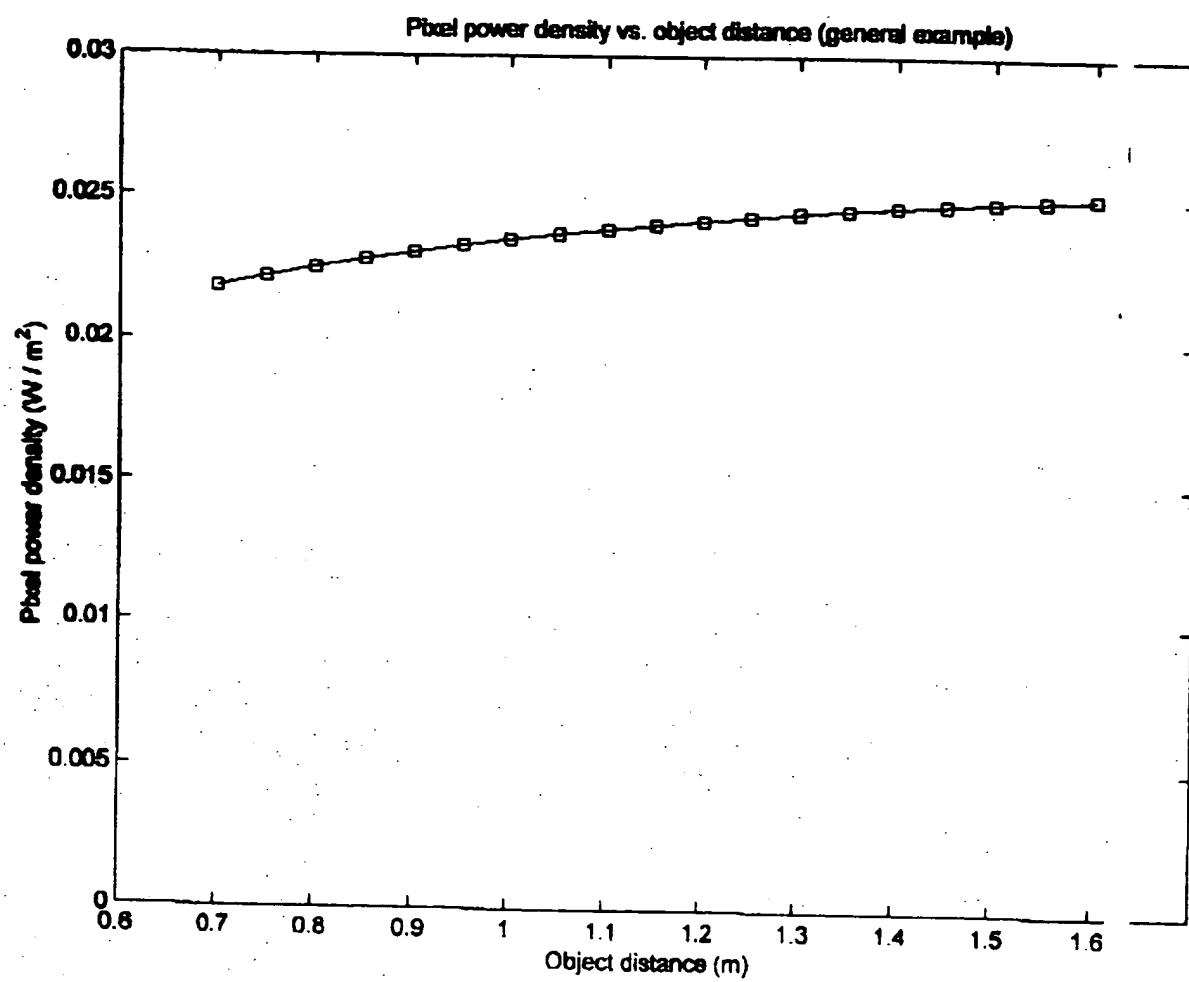


FIG. 1M1

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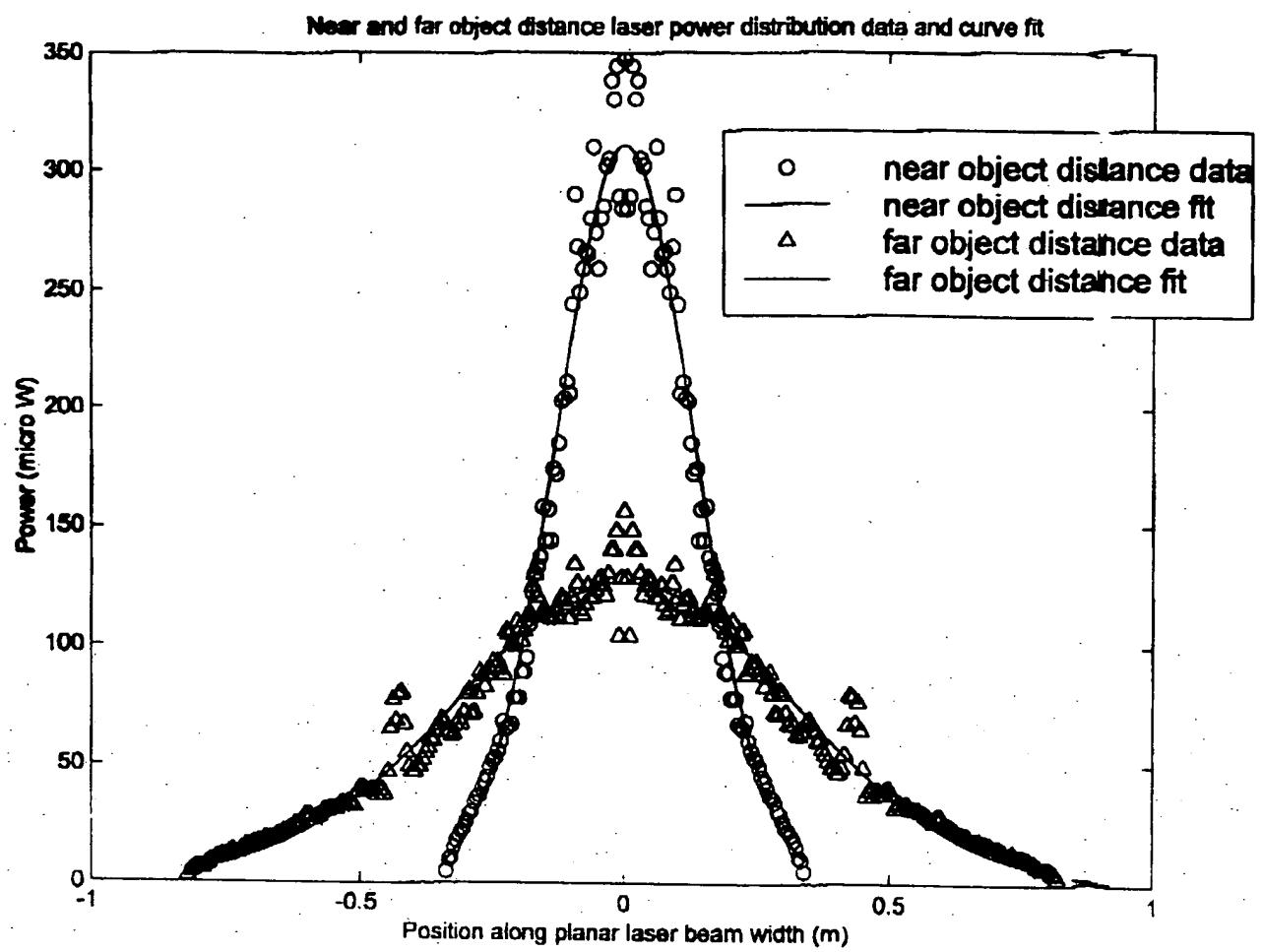


FIG. 1M2

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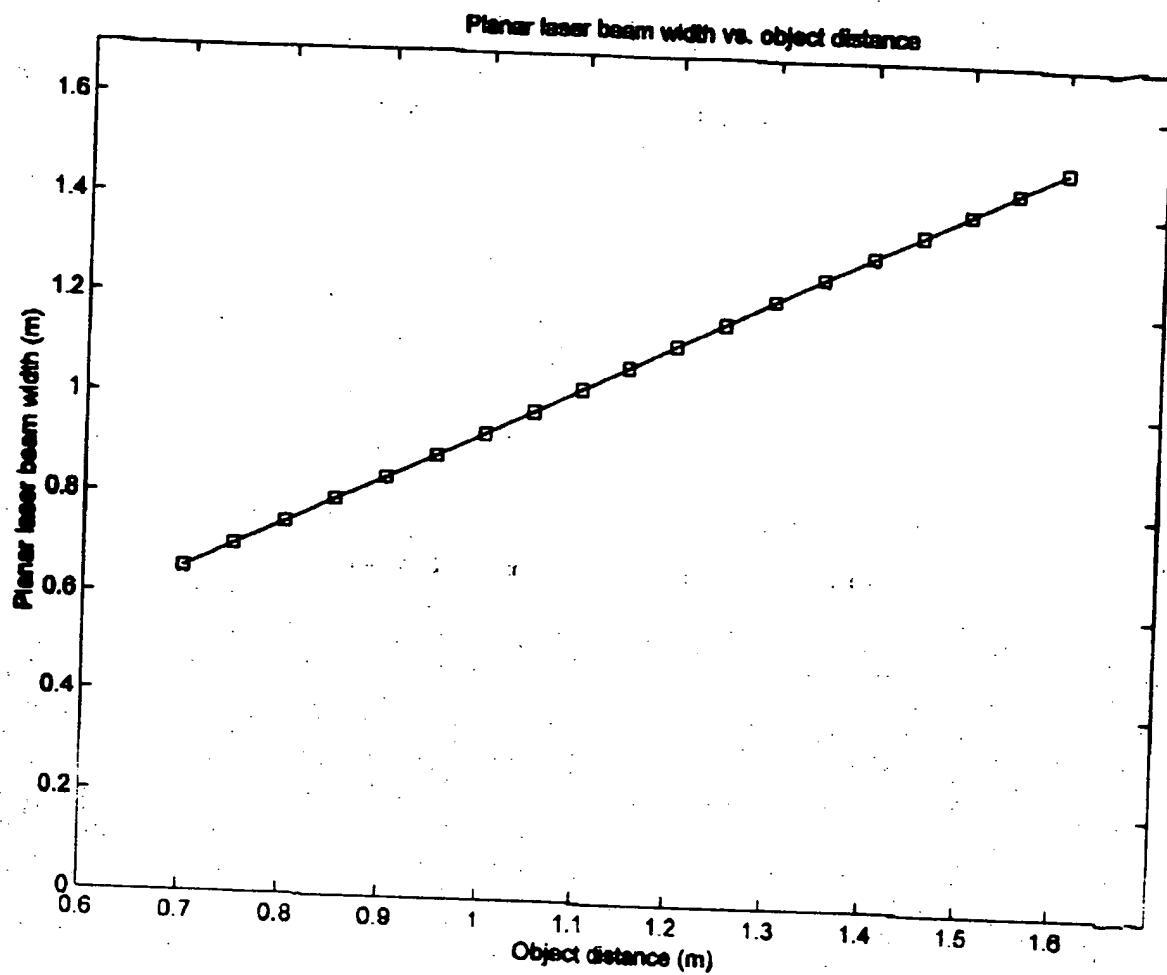


FIG. 1M3

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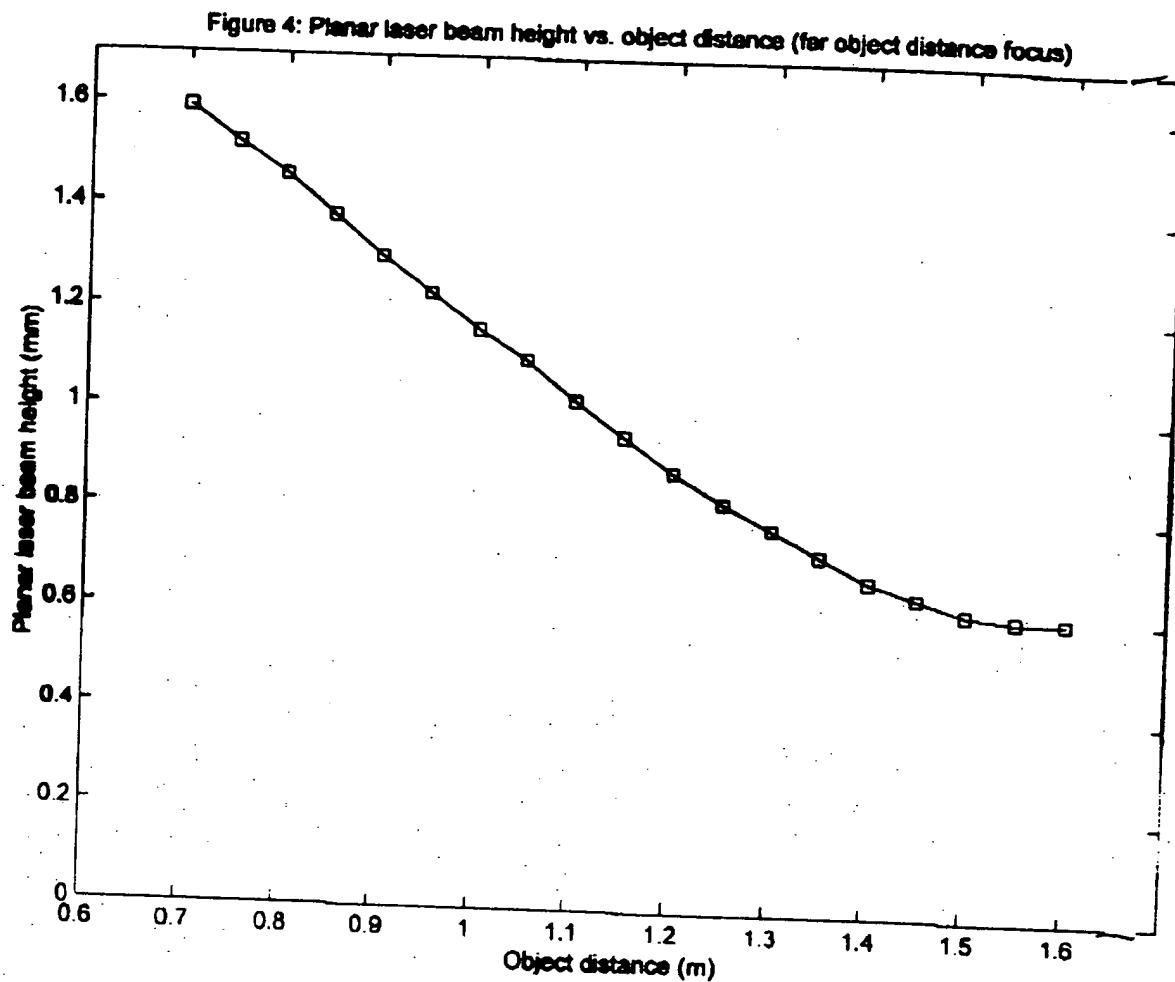


FIG 1M4

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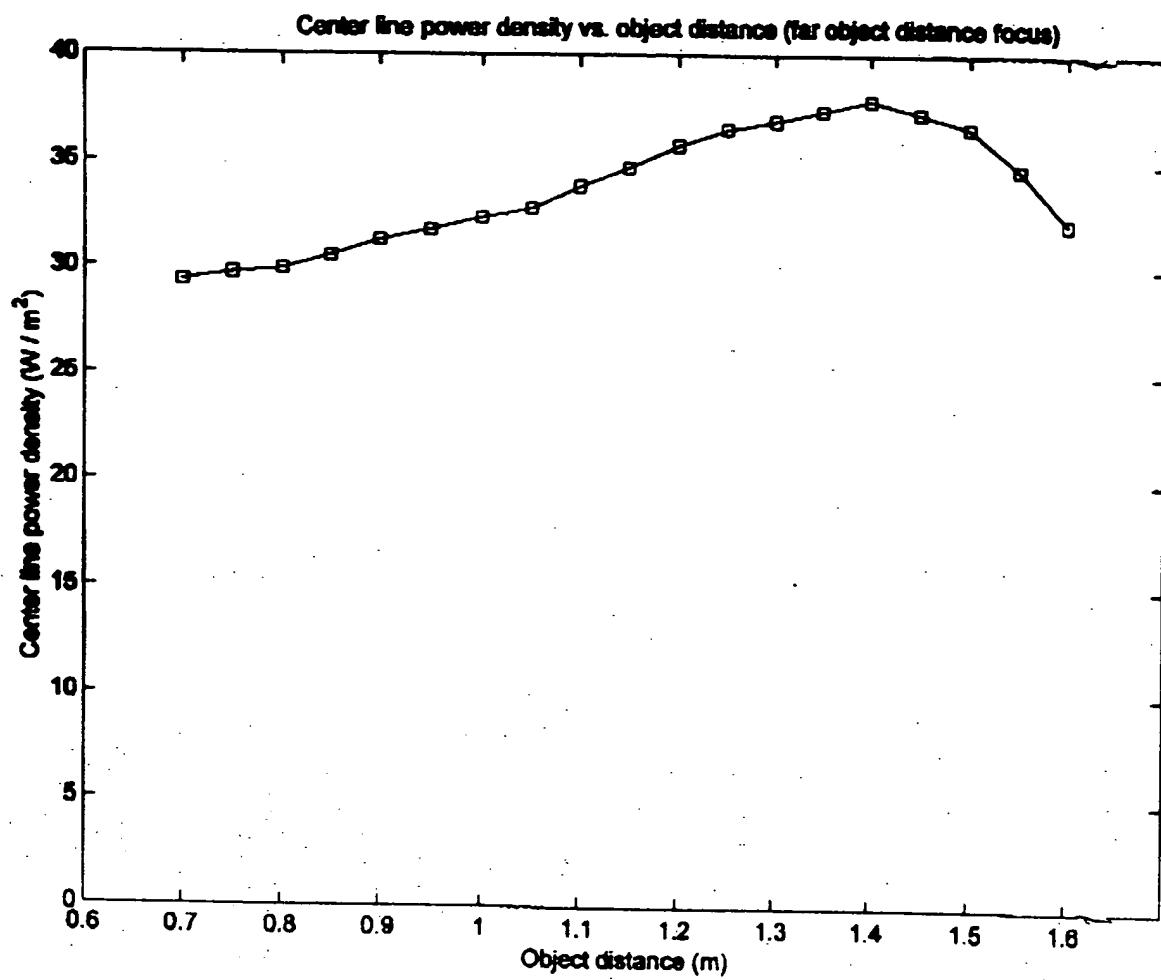


FIG. 1N

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Figure 6: Pixel power densities vs. object distance

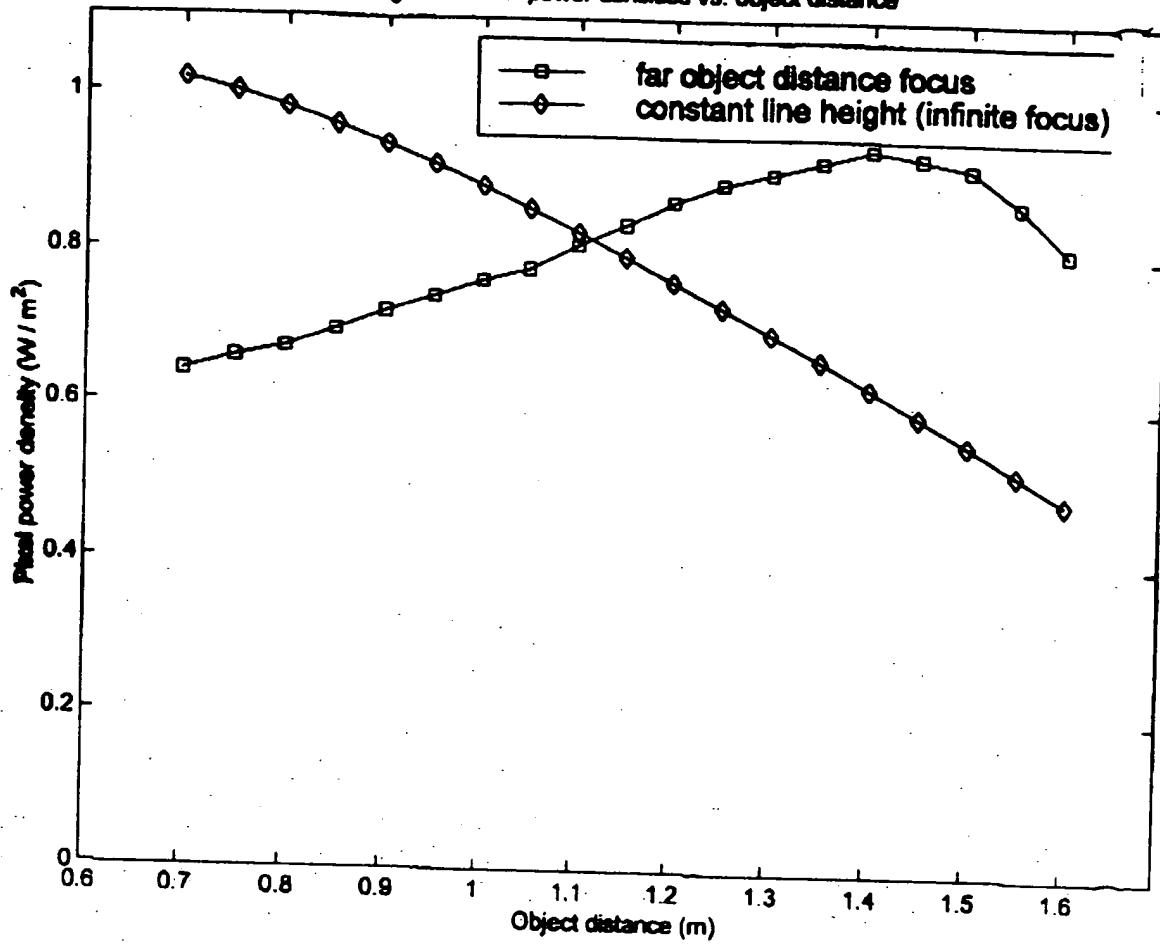


FIG. 10

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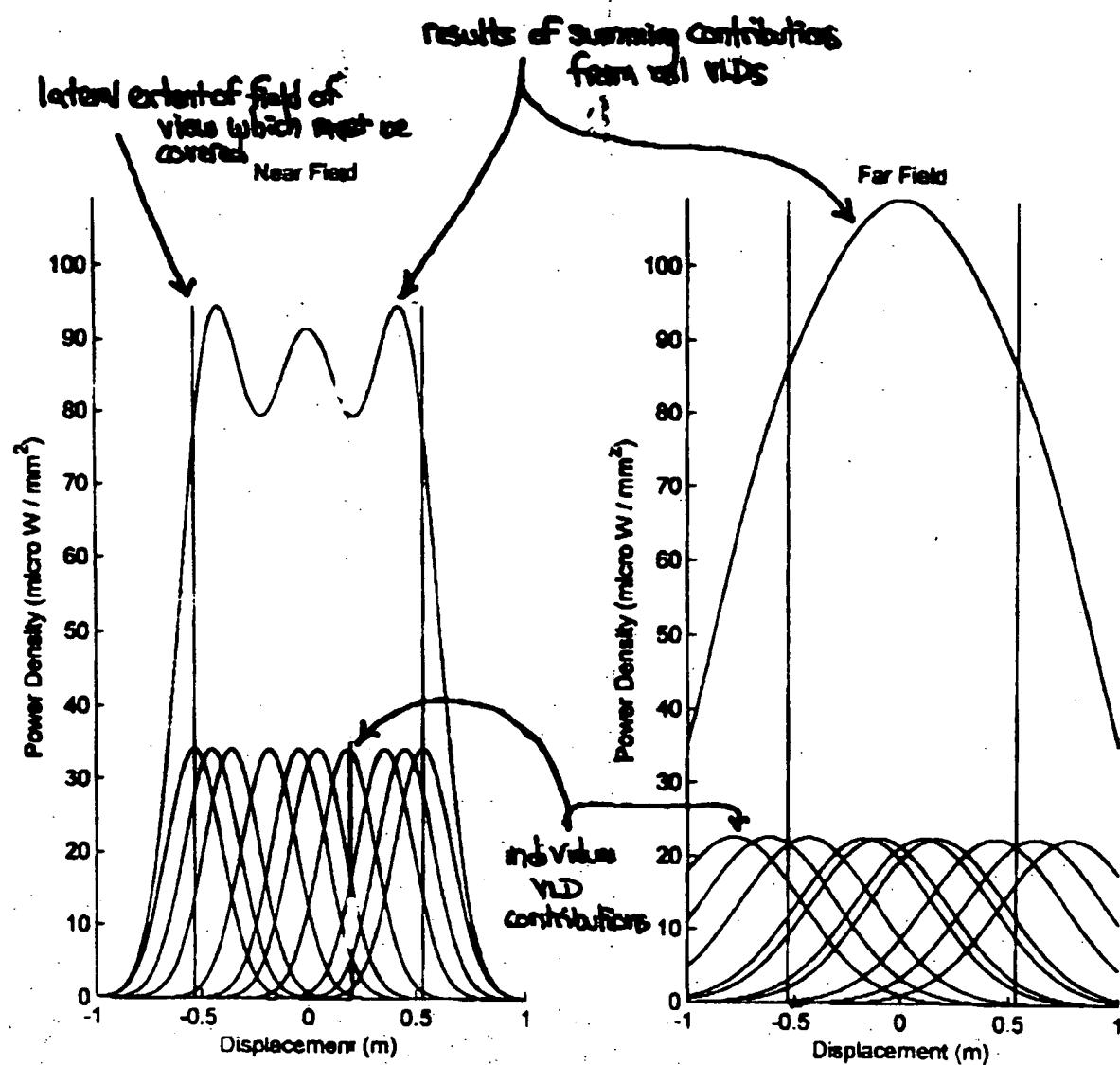


FIG 1P1

FIG 1P2

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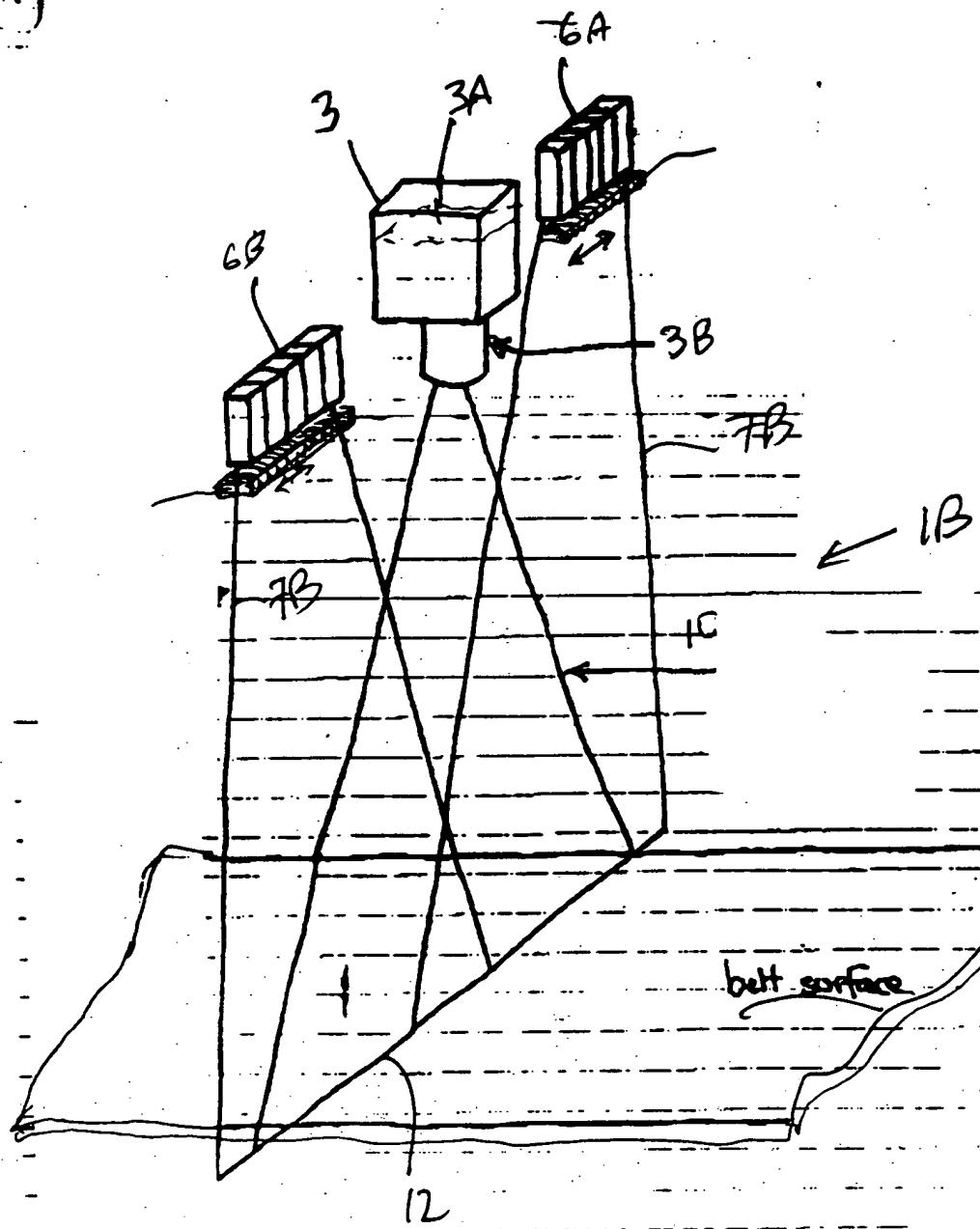


FIG. 1Q1

fixed feed length / fixed feed distance

3A

3B

3C

3D

3E

3F

3G

3H

3I

3J

3K

3L

3M

3N

3O

3P

3Q

3R

3S

3T

3U

3V

3W

3X

3Y

3Z

3AA

3AB

3AC

3AD

3AE

3AF

3AG

3AH

3AI

3AJ

3AK

3AL

3AM

3AN

3AO

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3AQ

3AR

3AS

3AT

3AU

3AV

3AW

3AX

3AY

3AZ

3AAU

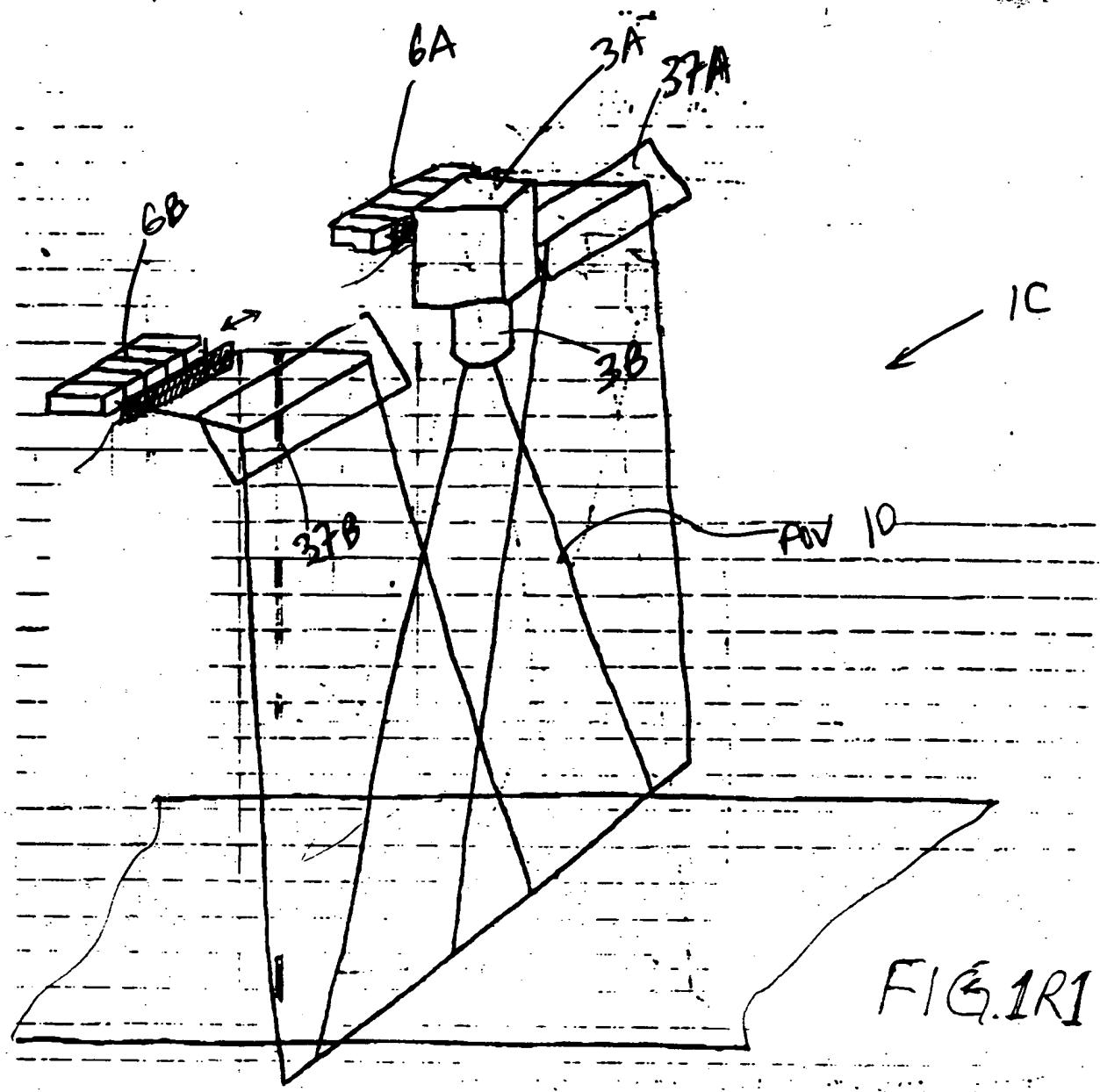
3ABV

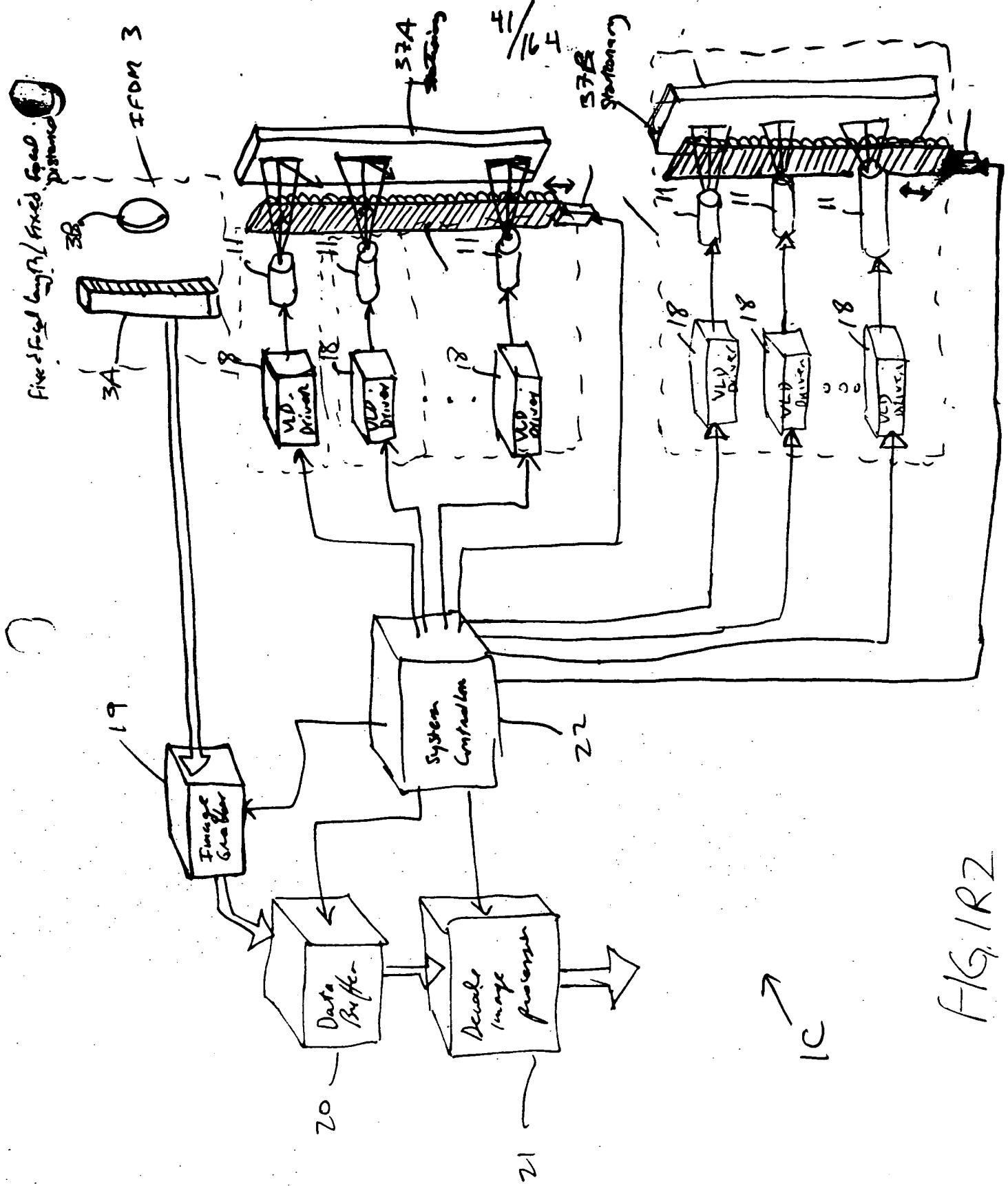
3ACW

3ADX

3AEY

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F1G.1R2

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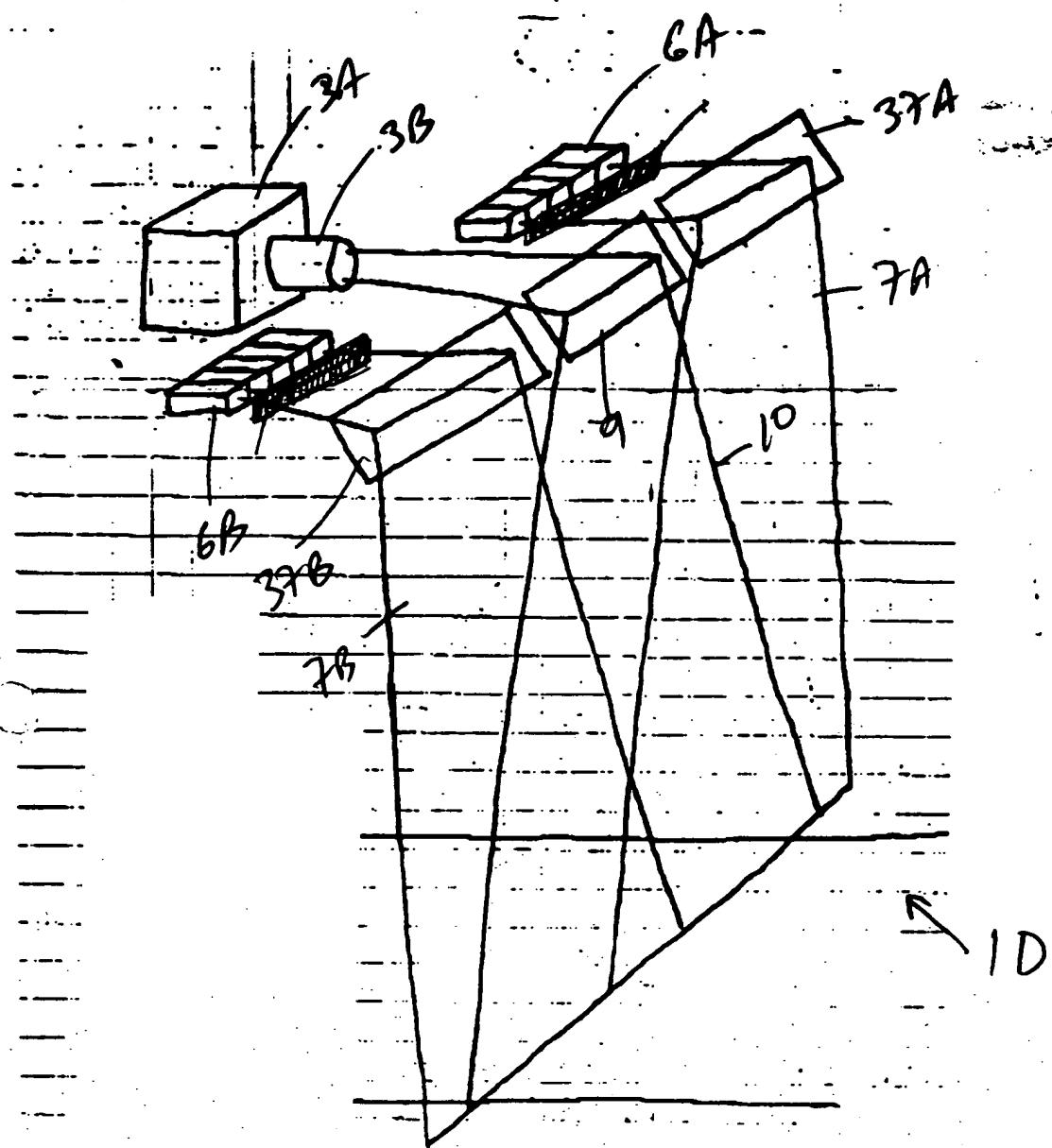
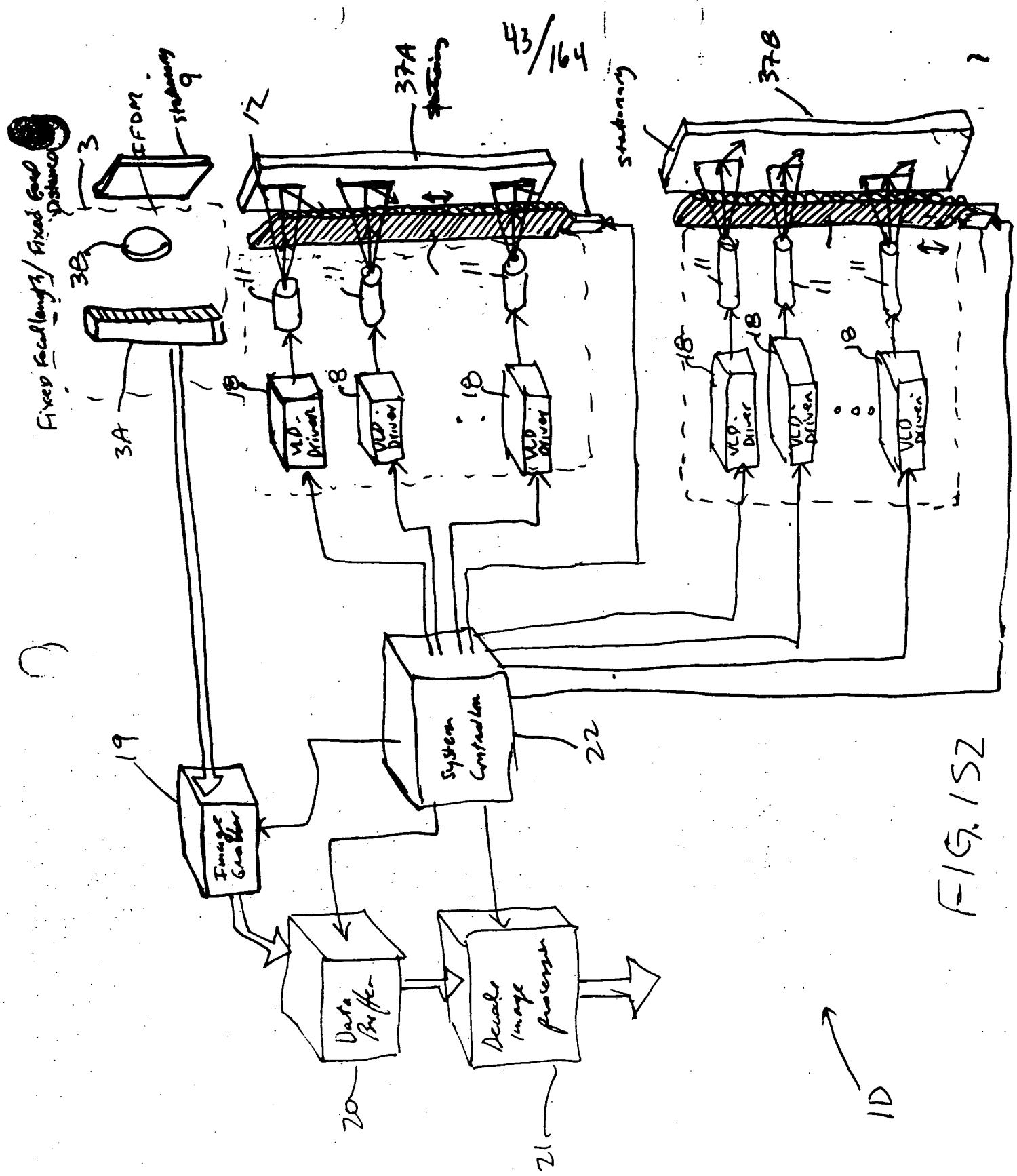


FIG. 1S1



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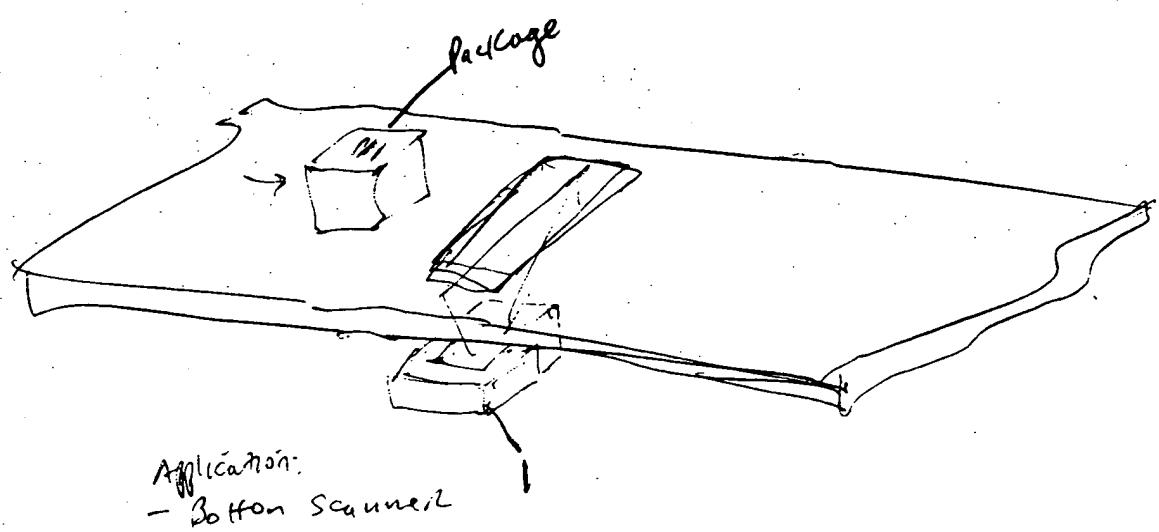


FIG. 1T

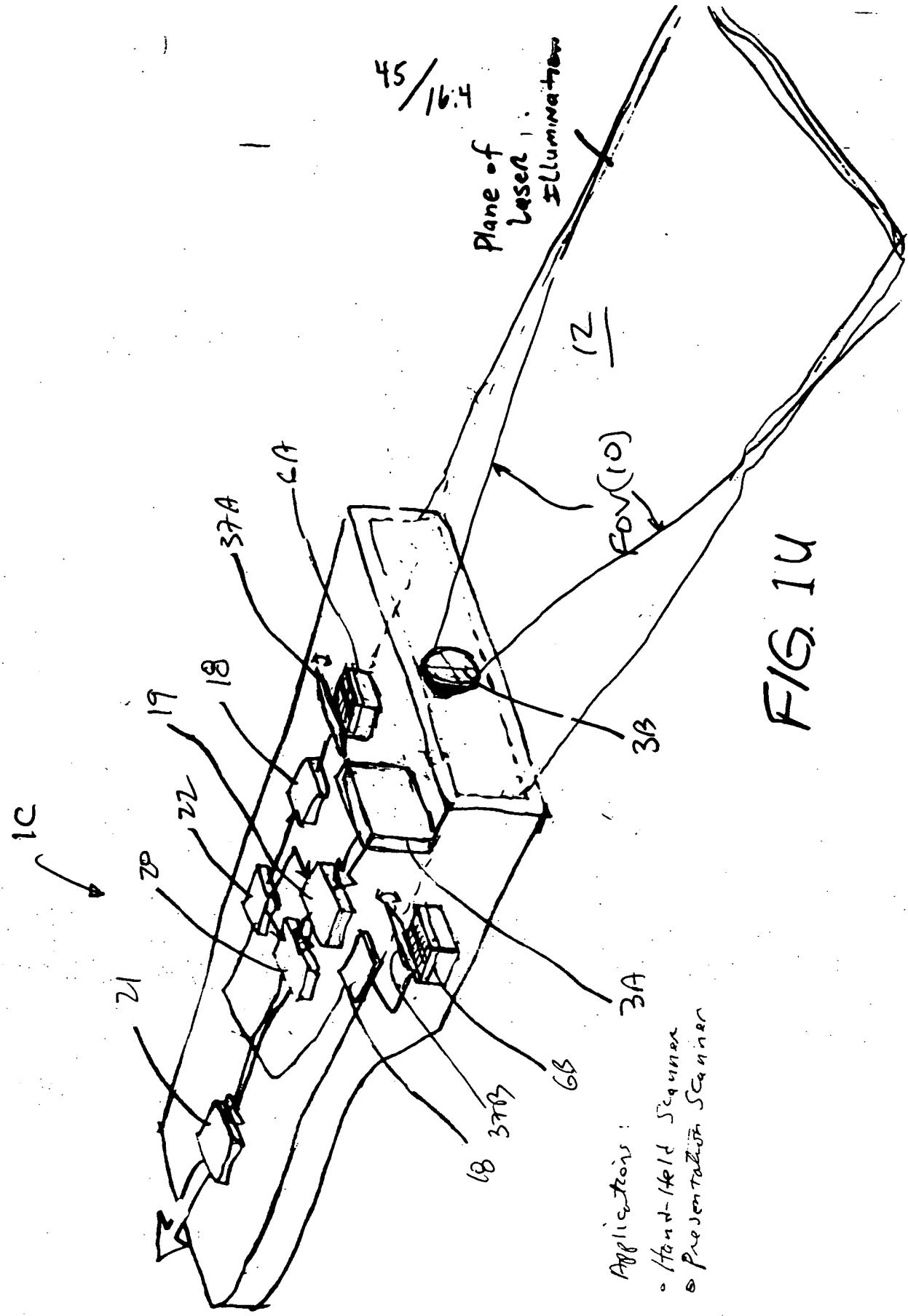


FIG. 14

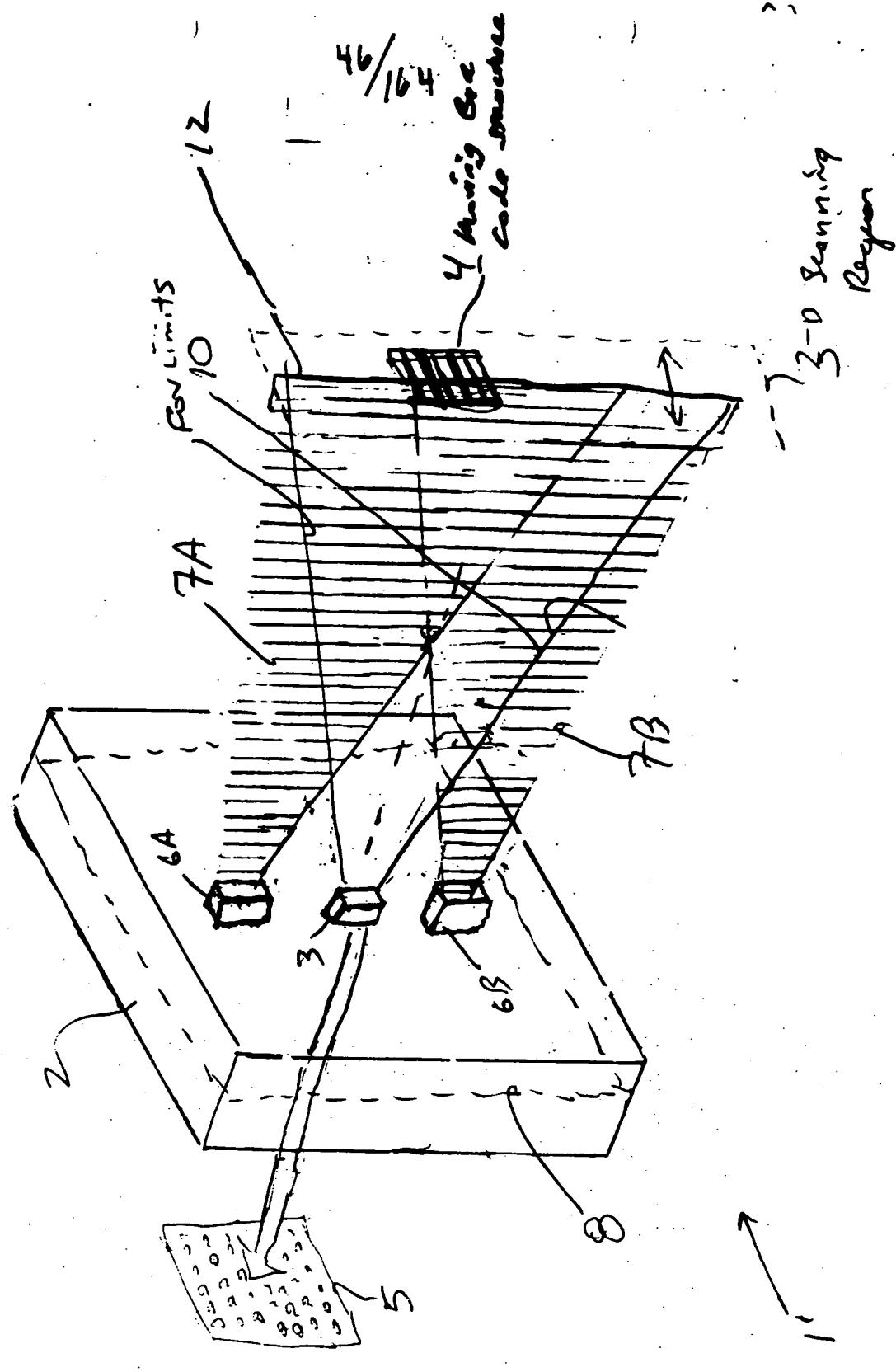


FIG. 1VI

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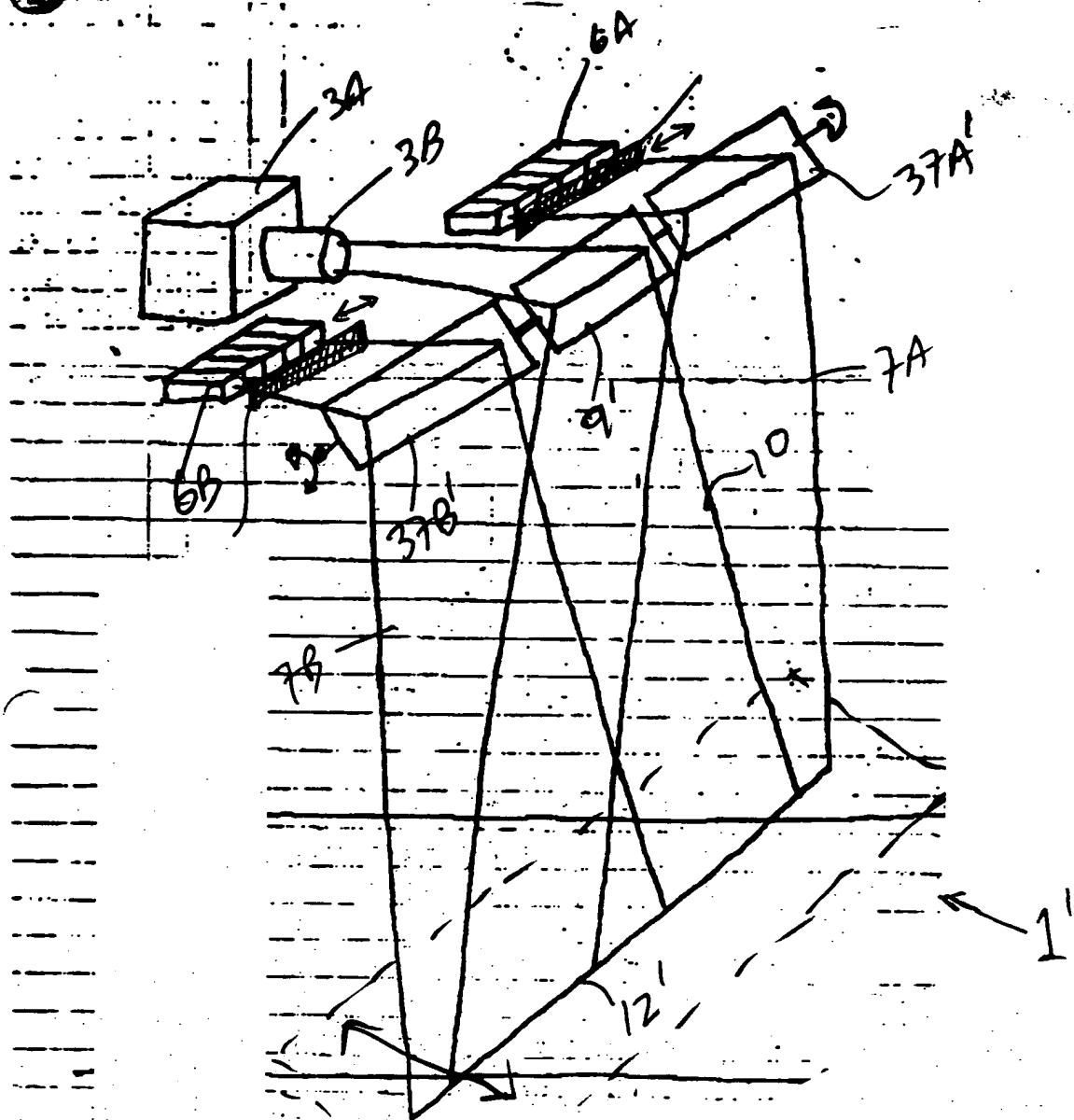
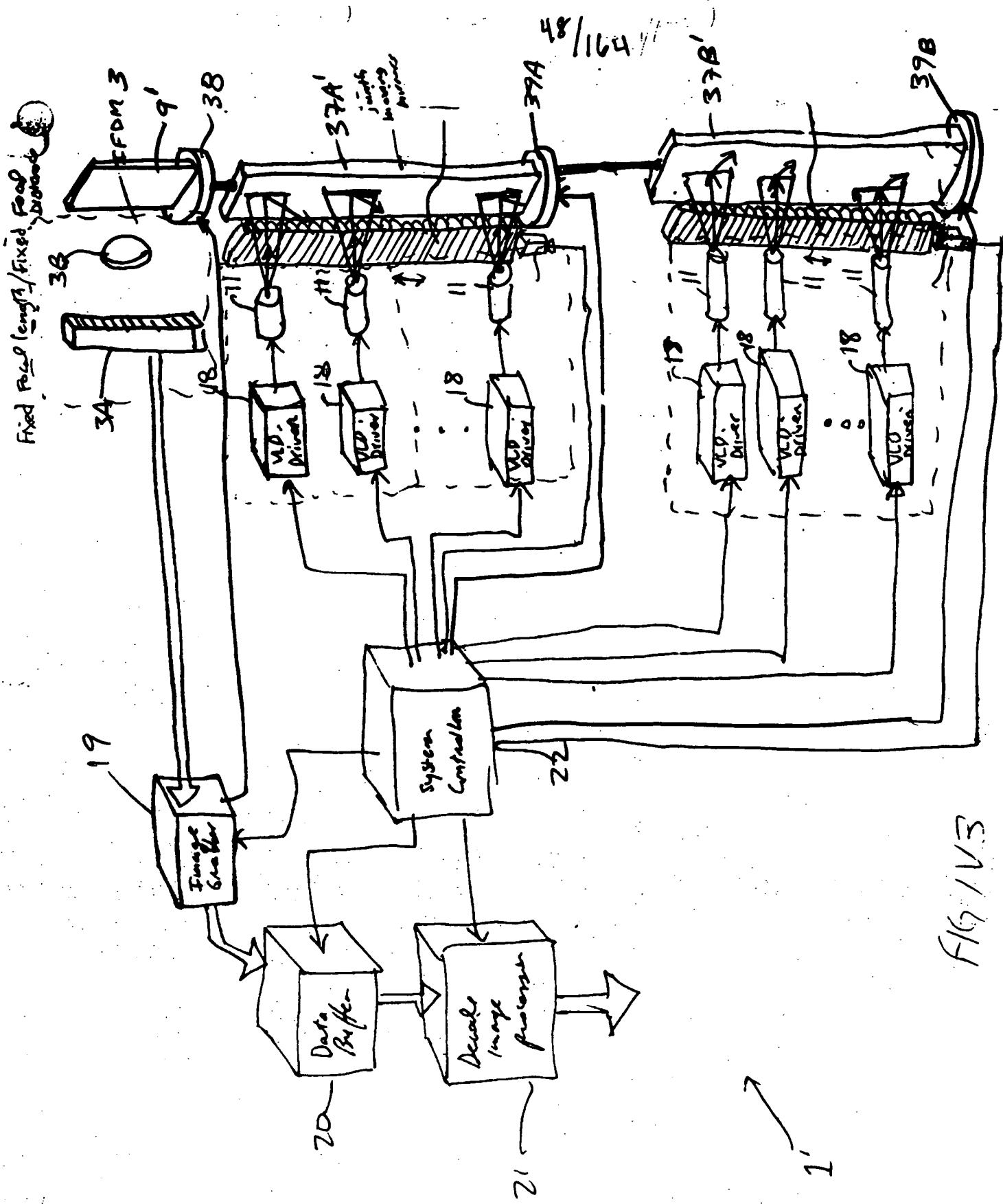


FIG. IV2

2-D
region
of
space



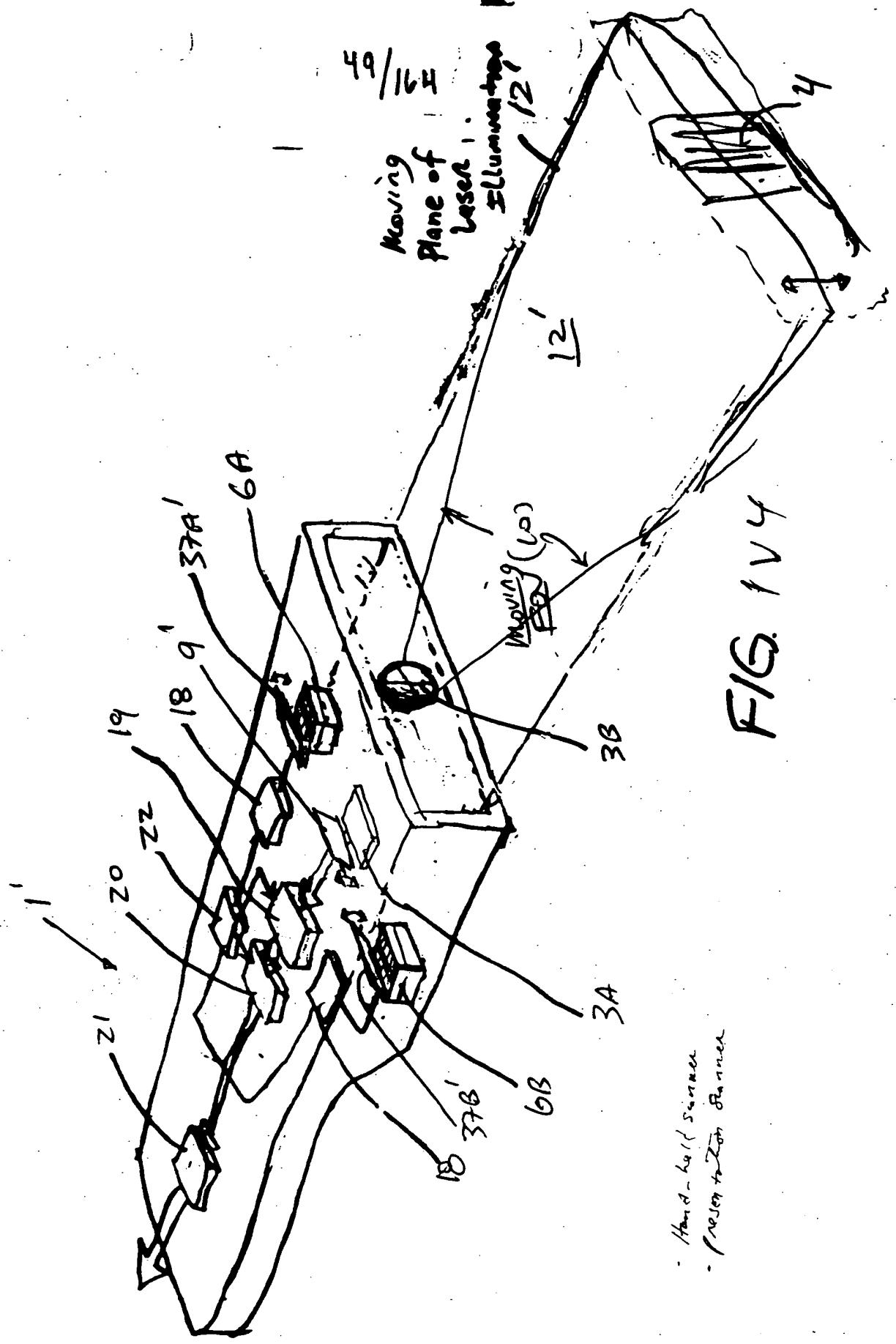
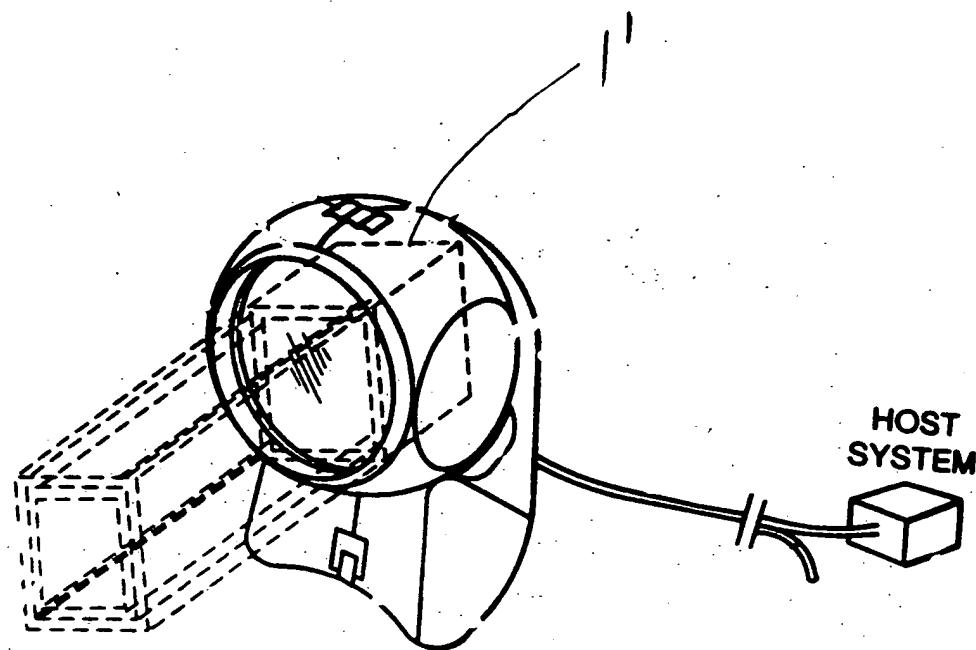


FIG. 1V4

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(Presentation type scanner)

FIG. IV5

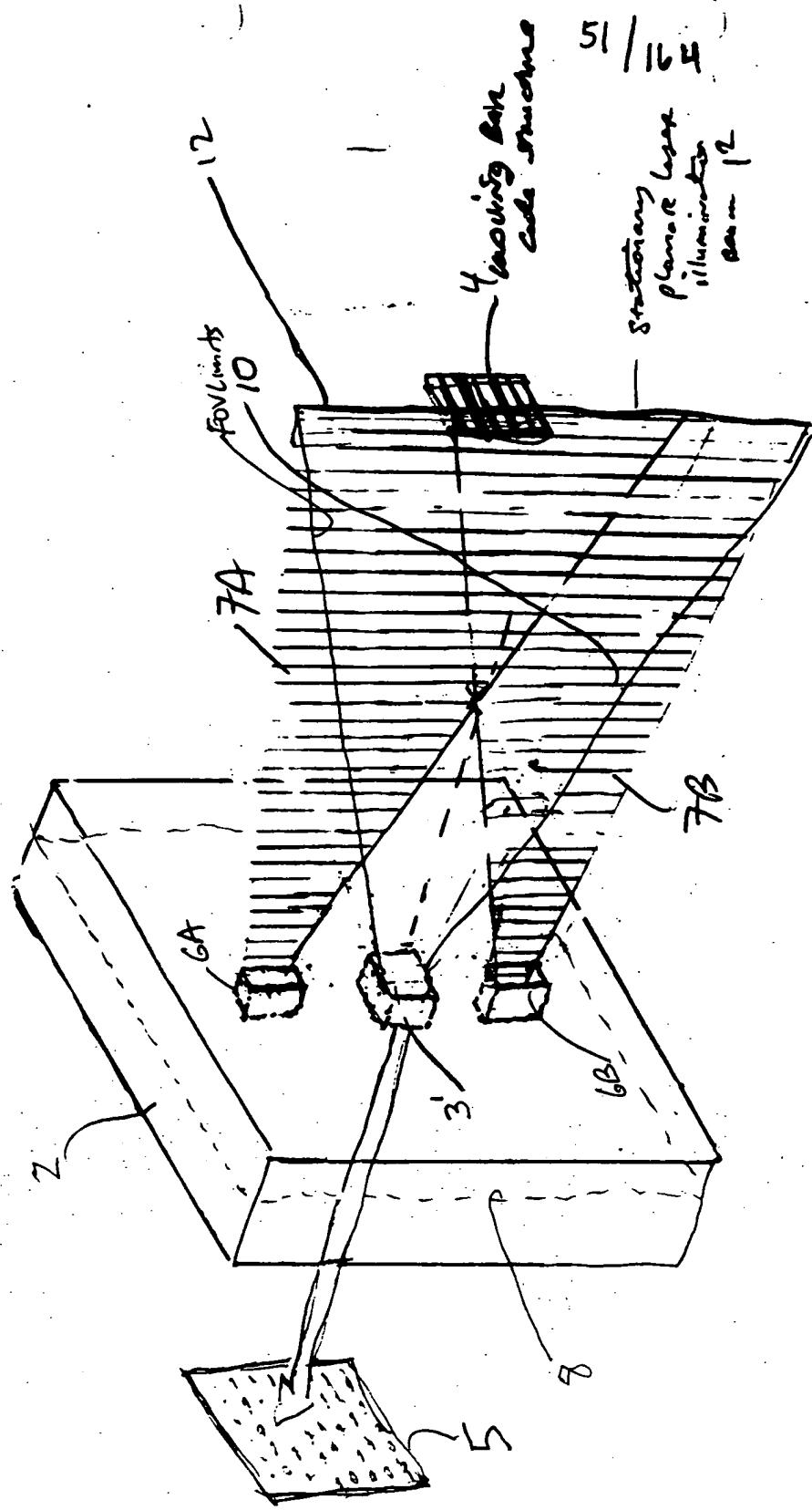


FIG. 2A

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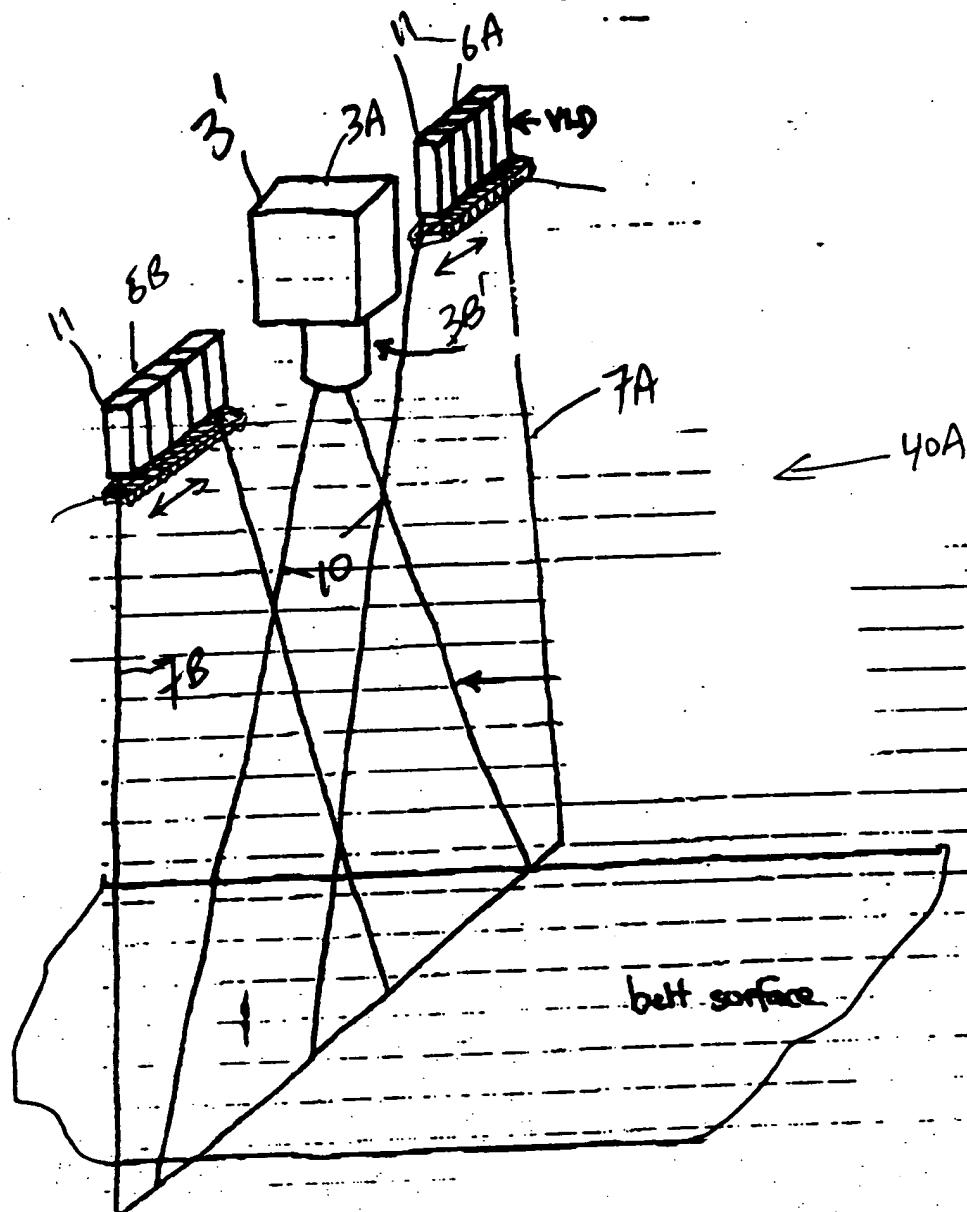


FIG. 2 B1

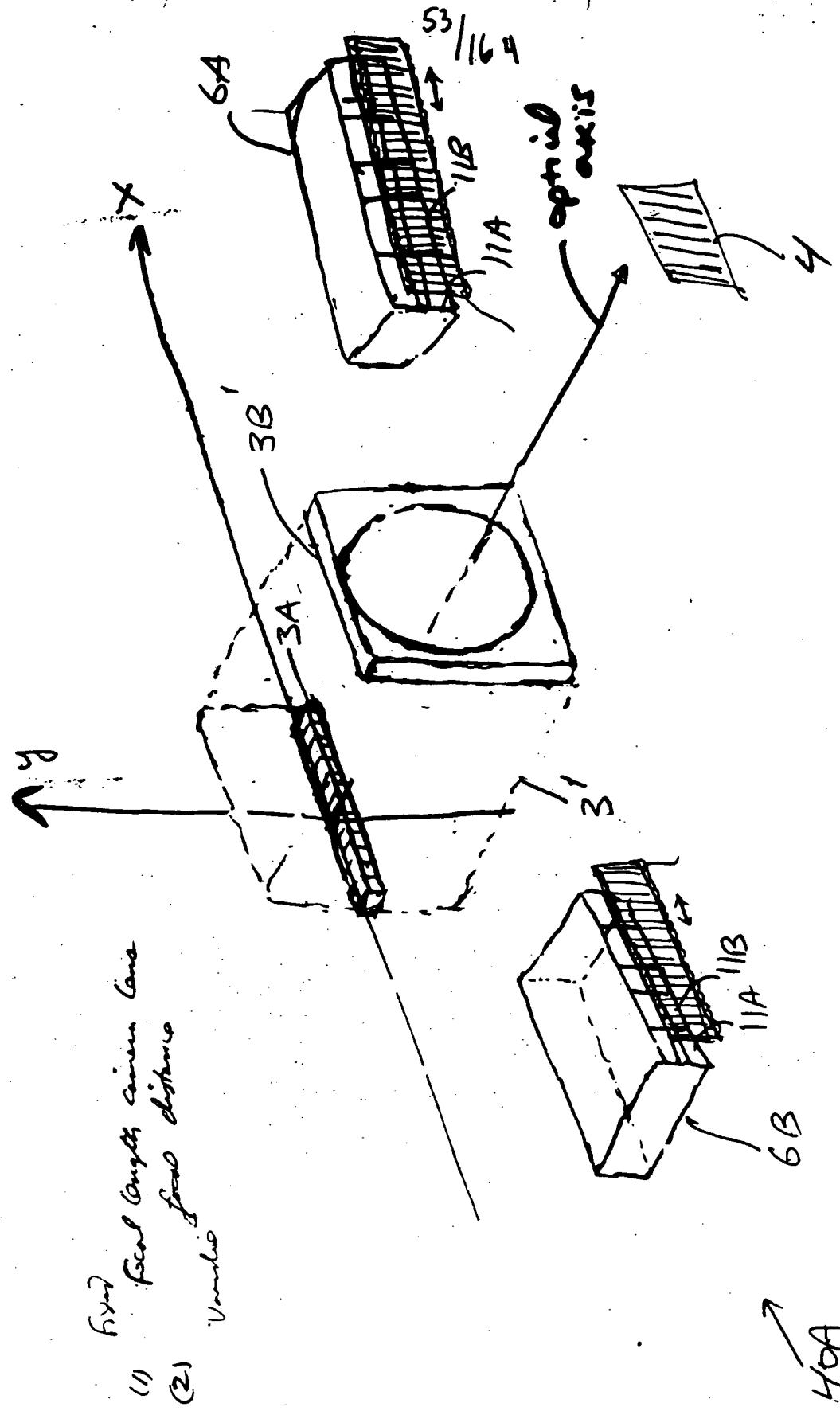


FIG. 2B2

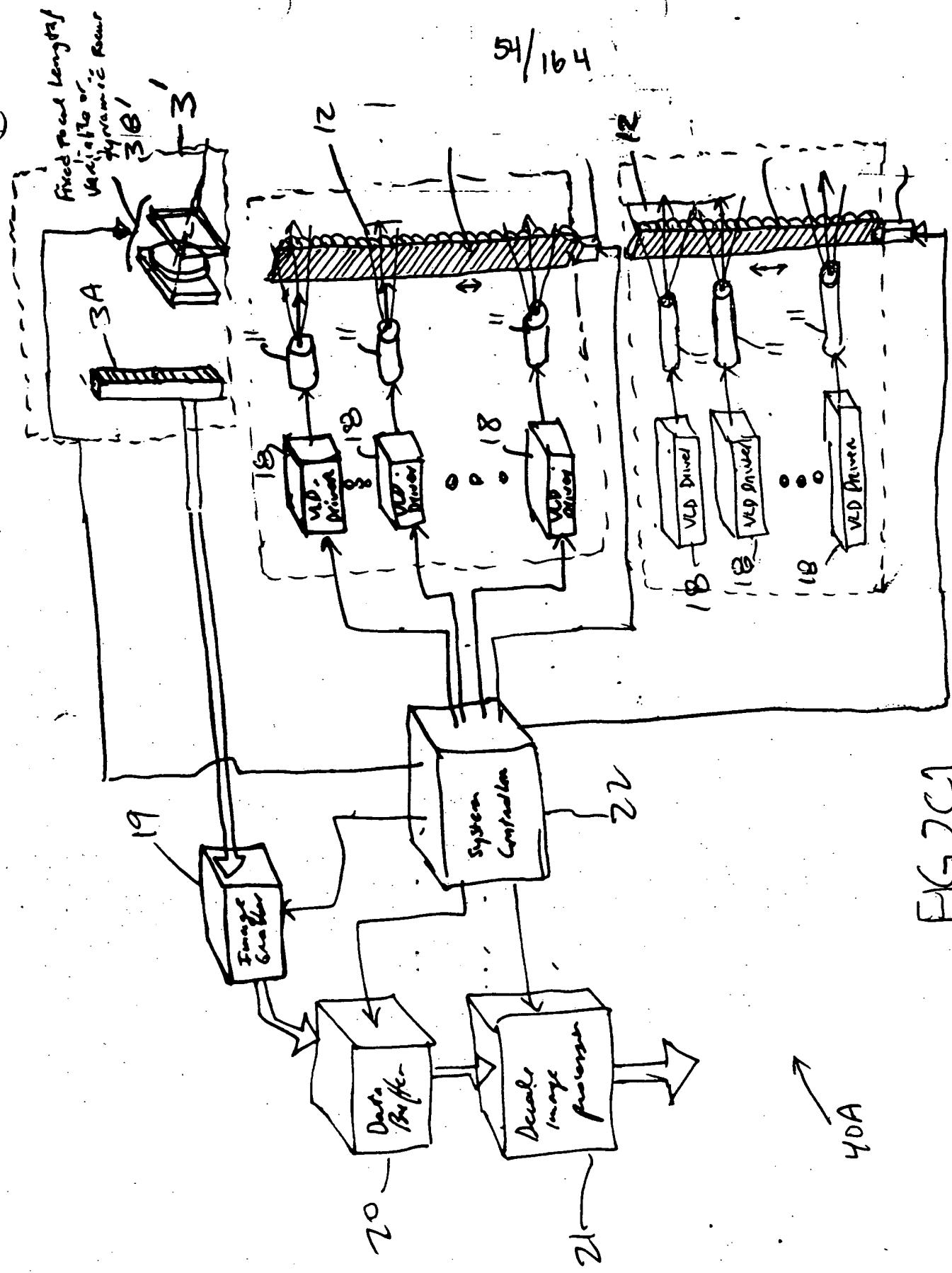


Fig. 2c1

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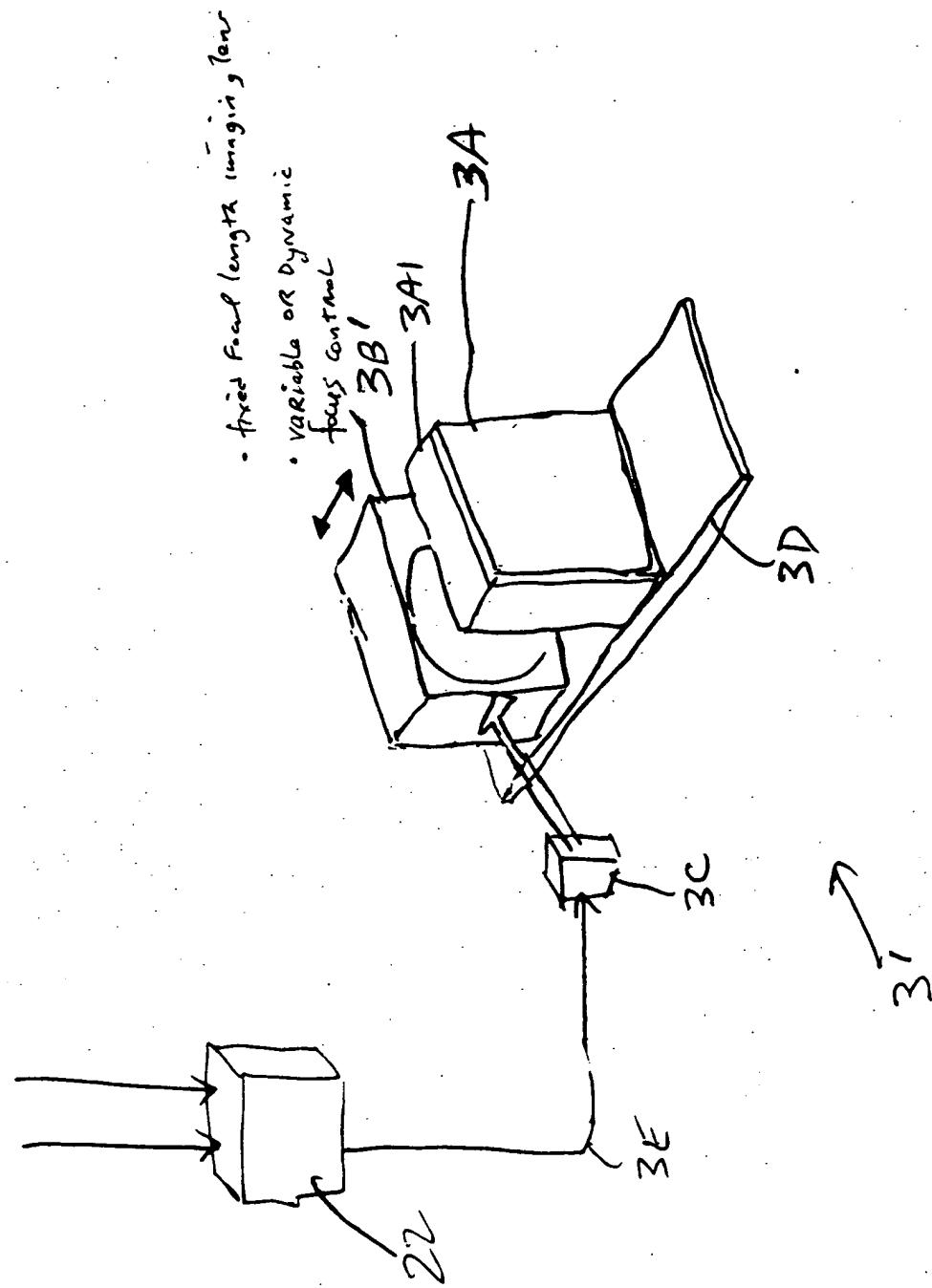


FIG. 2C2

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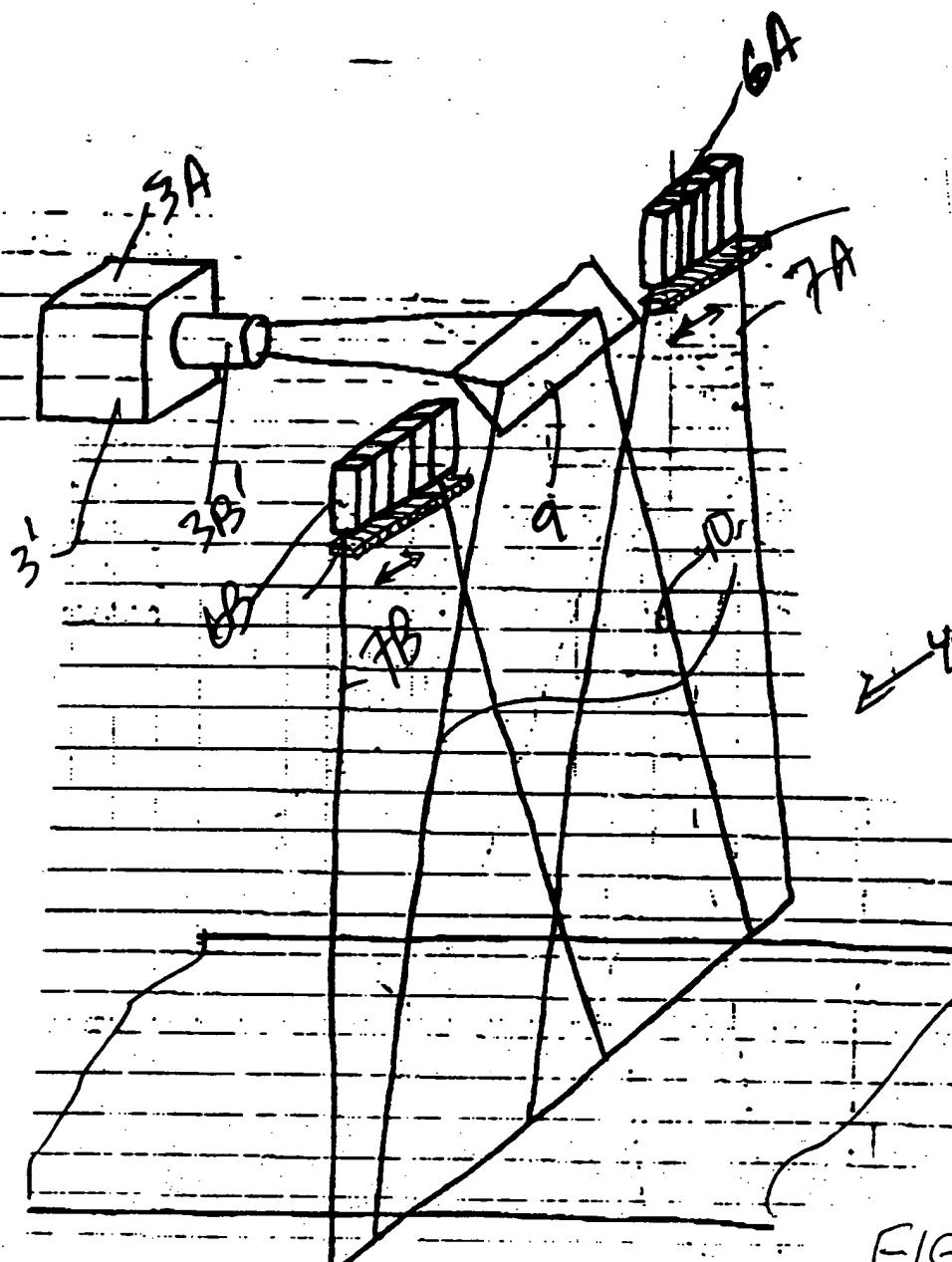
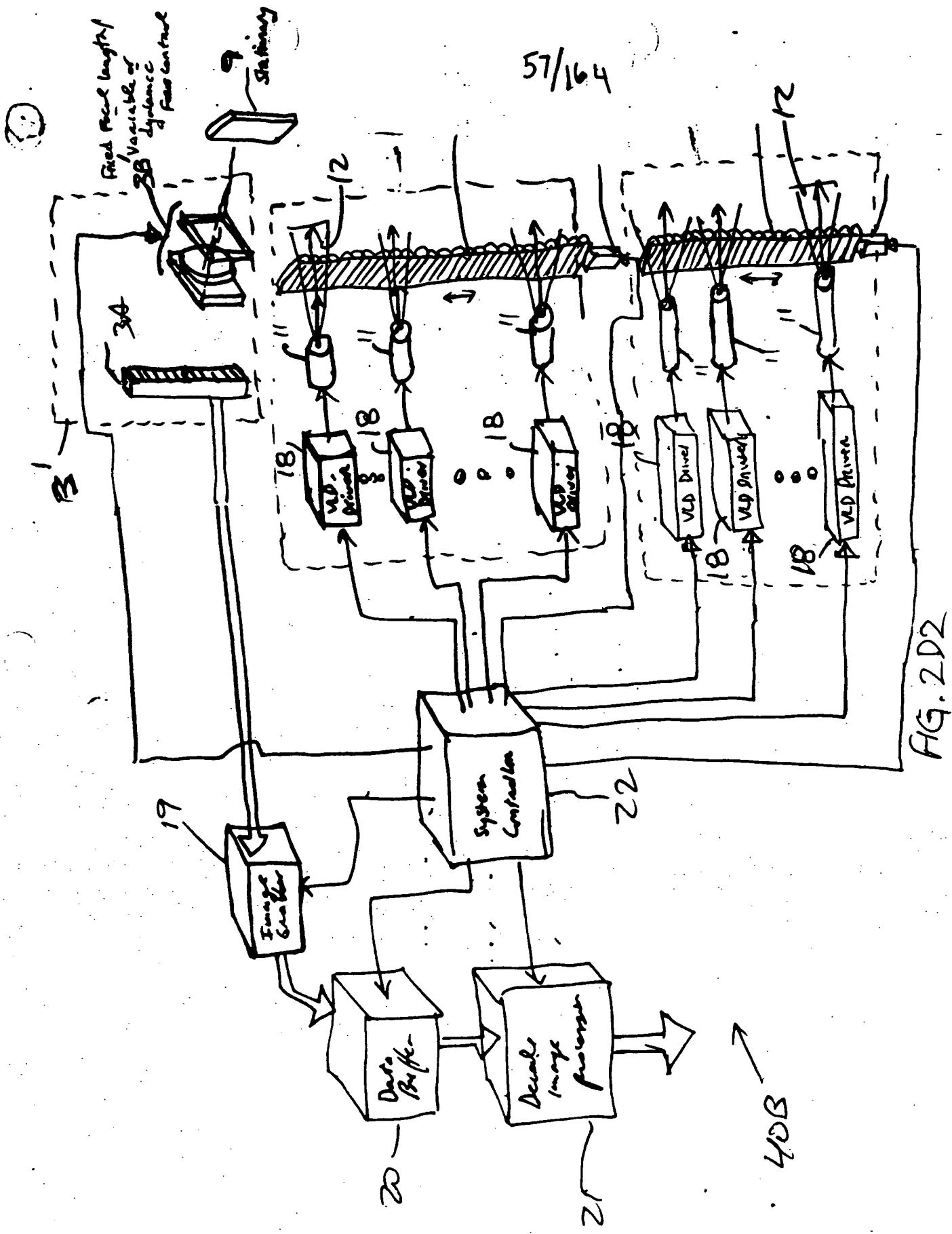


FIG. 2D1



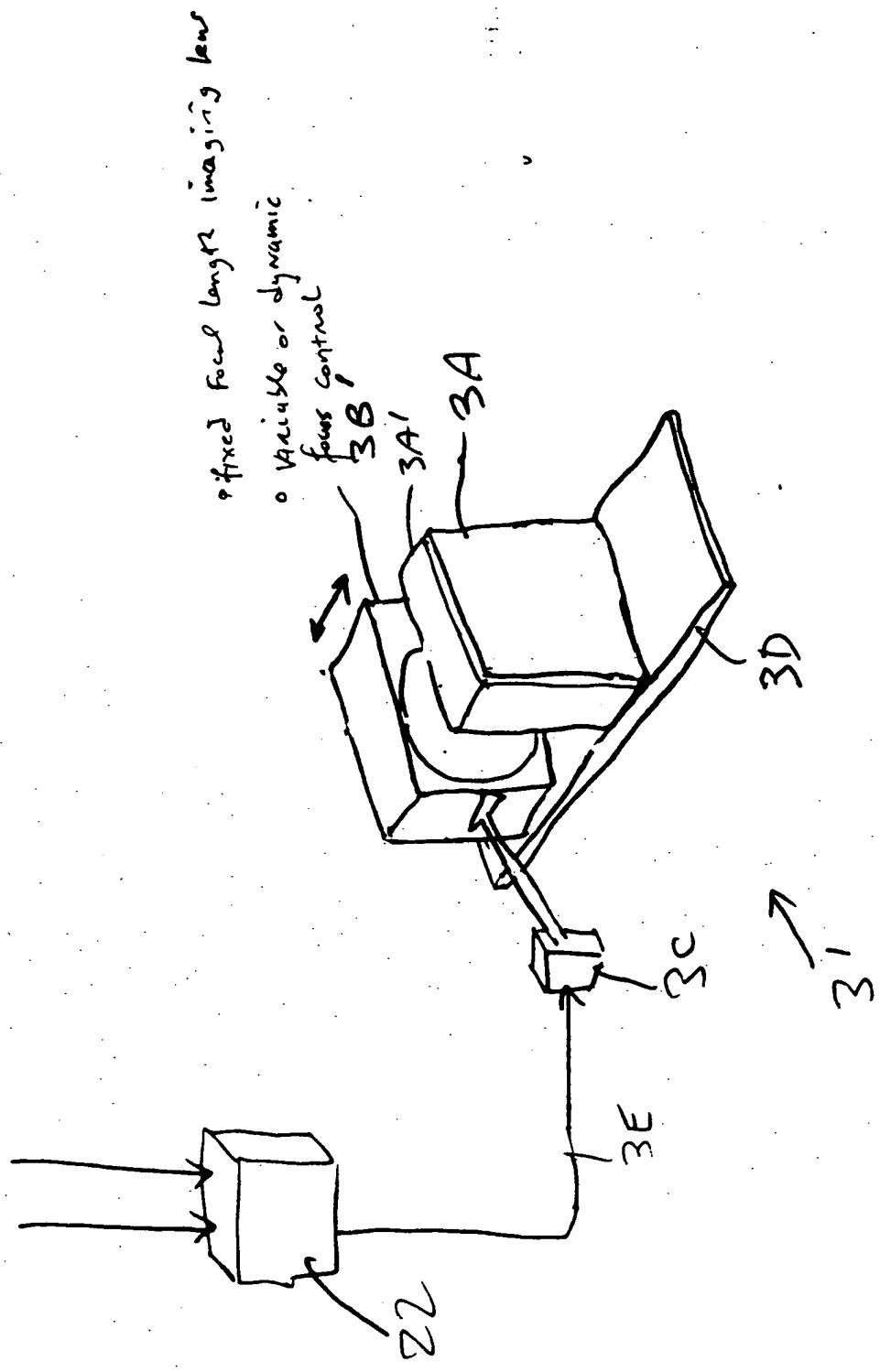


FIG. 2D3

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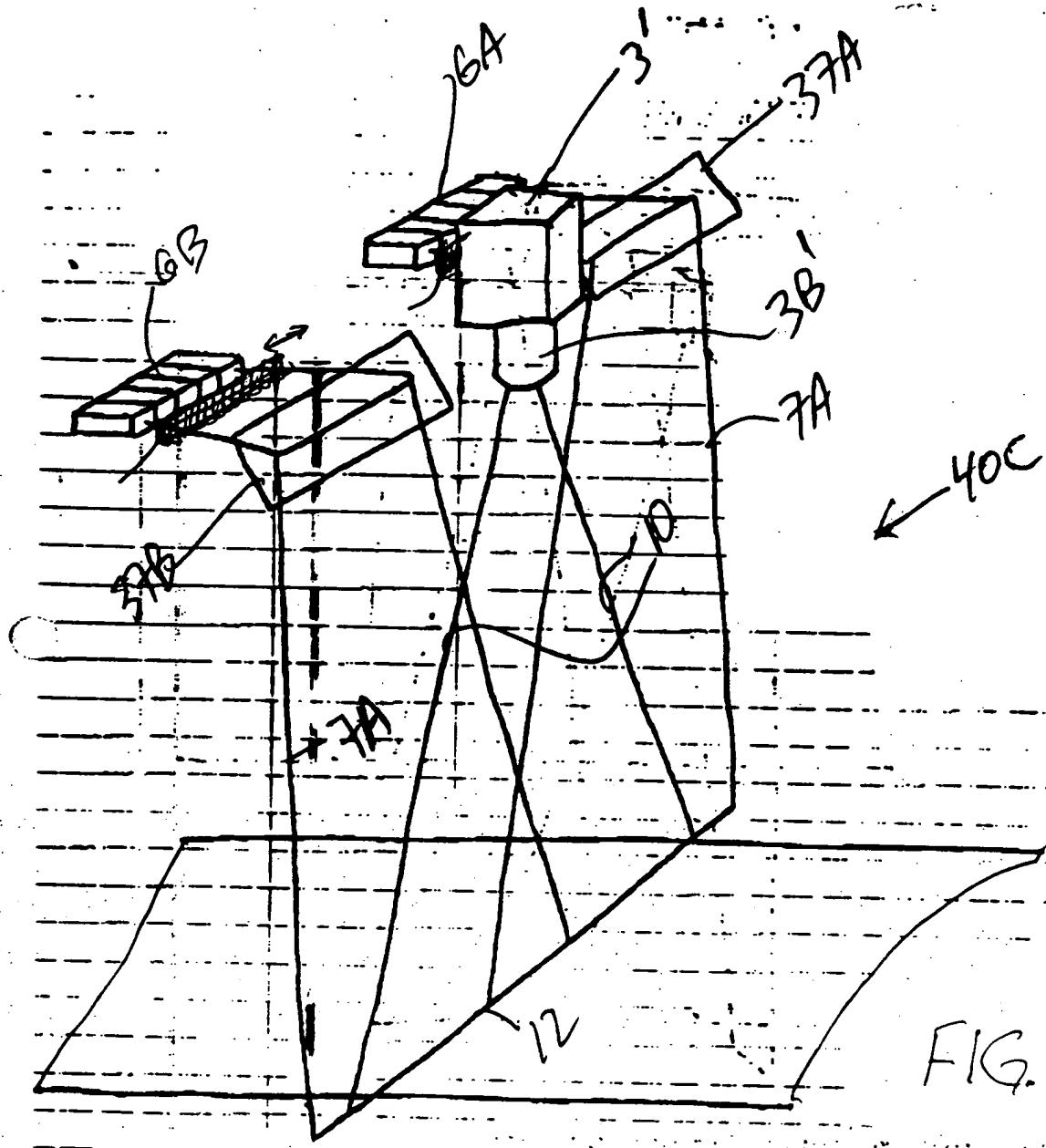


FIG. 2E1

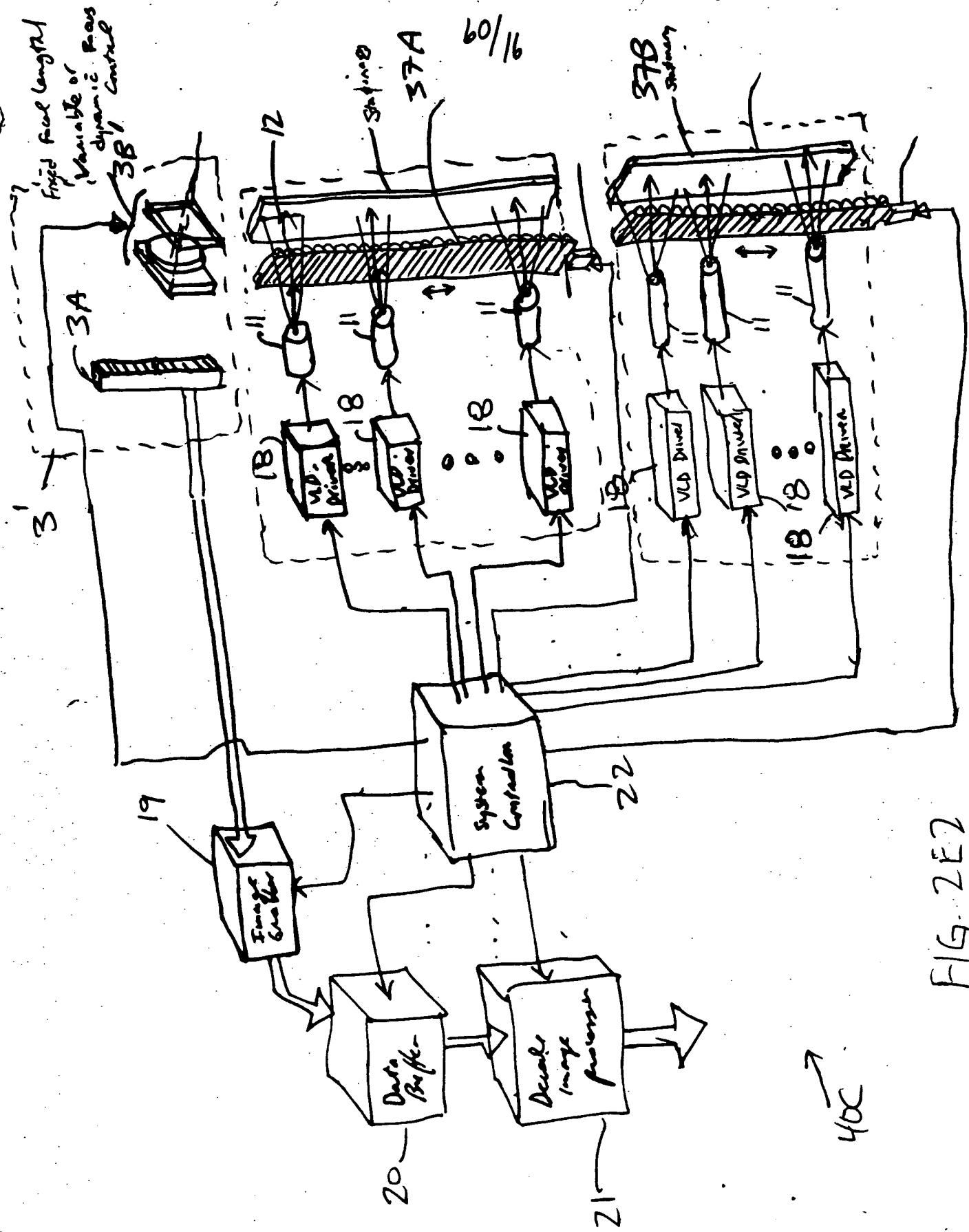


FIG. 2 E2

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- Fixed focal length imaging lens

Variables or dynamics
Final control 3B 3A1

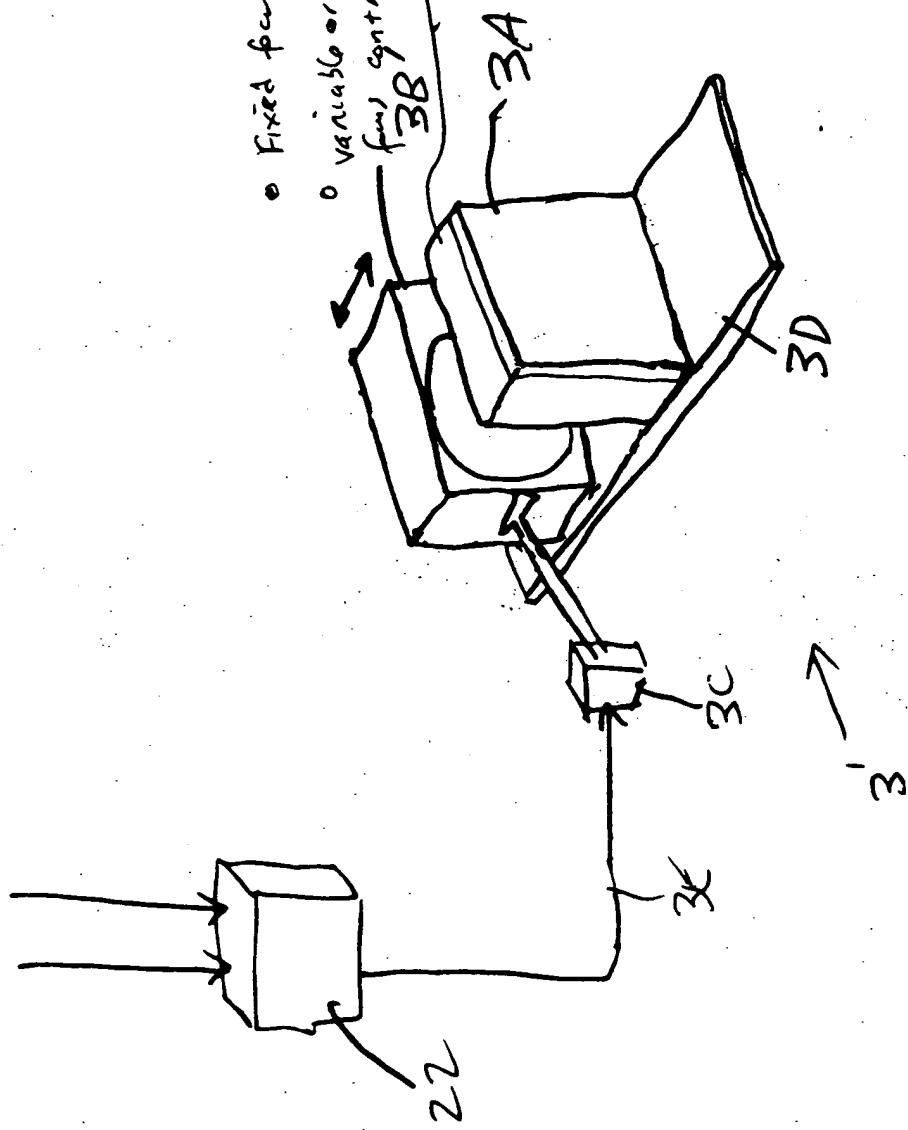


FIG. 2 E 3

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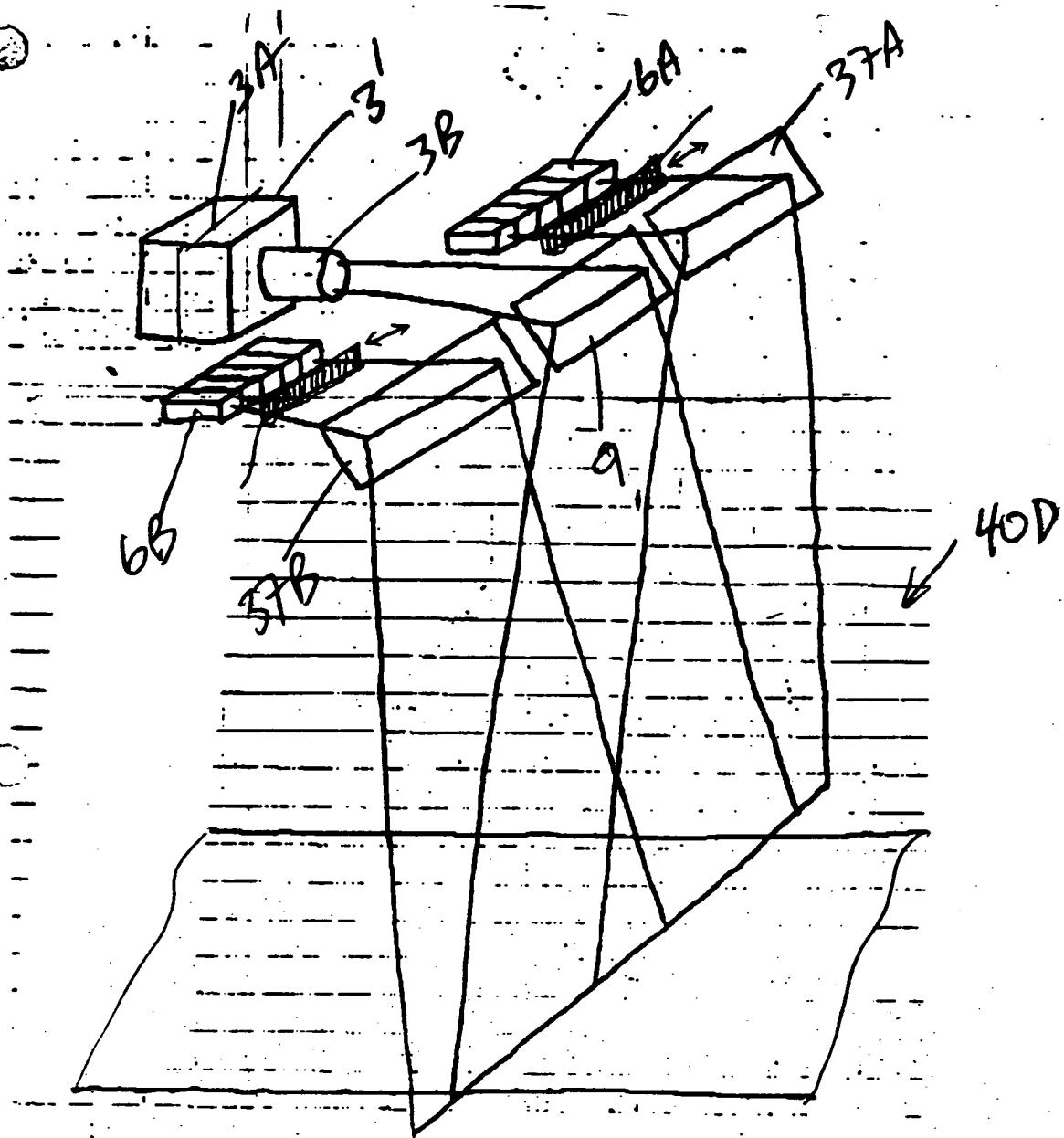


FIG. 2F1

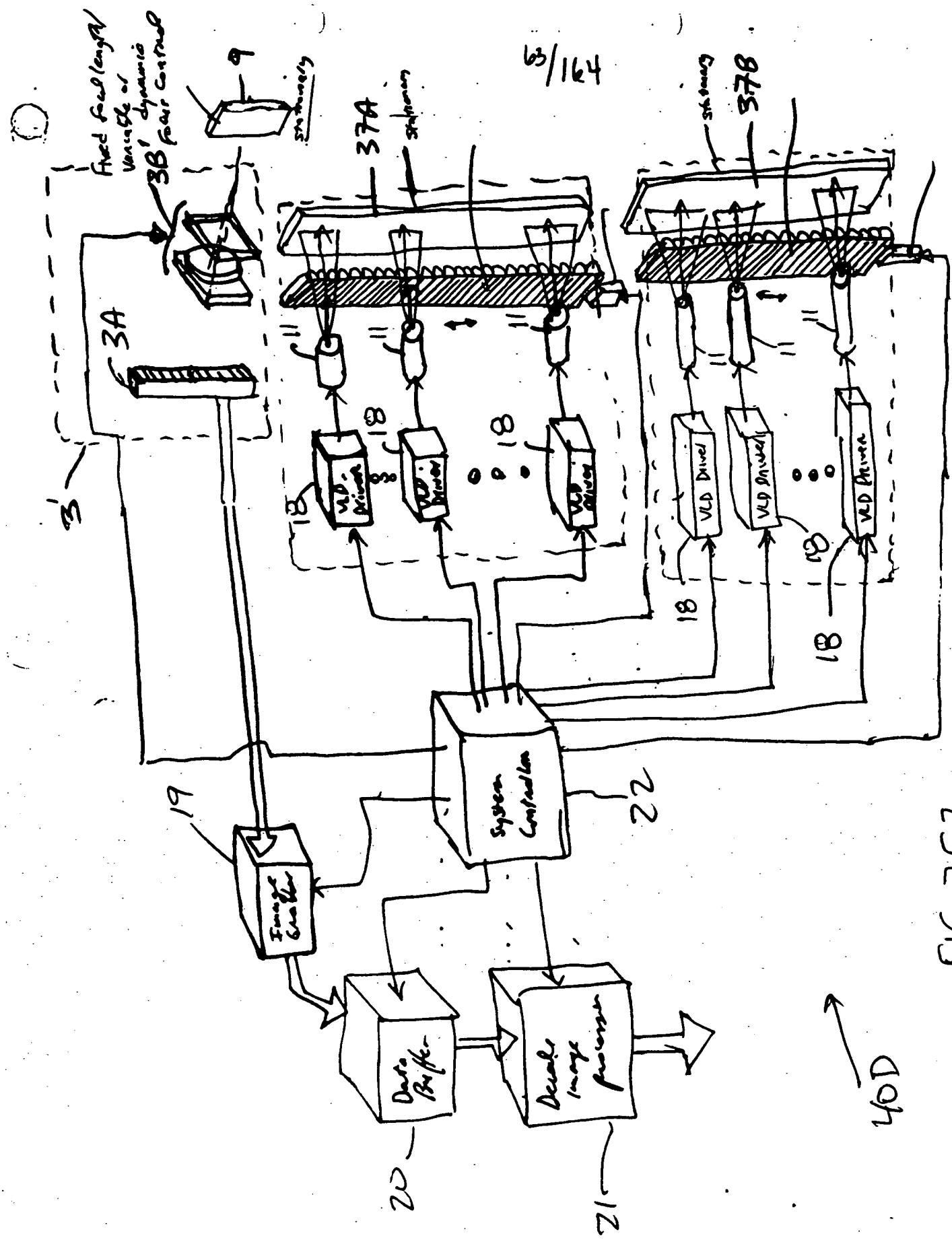


FIG. 2F2

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o Fixed focal length imaging lens

o Variable focus or dynamic focus

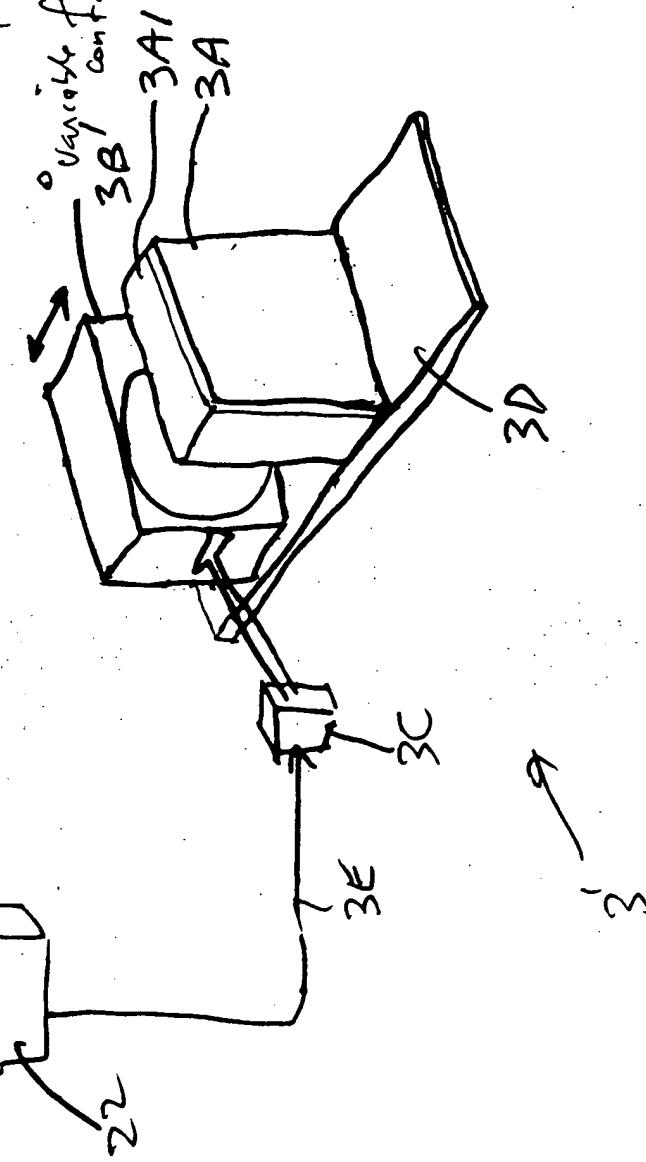


FIG. 2F3

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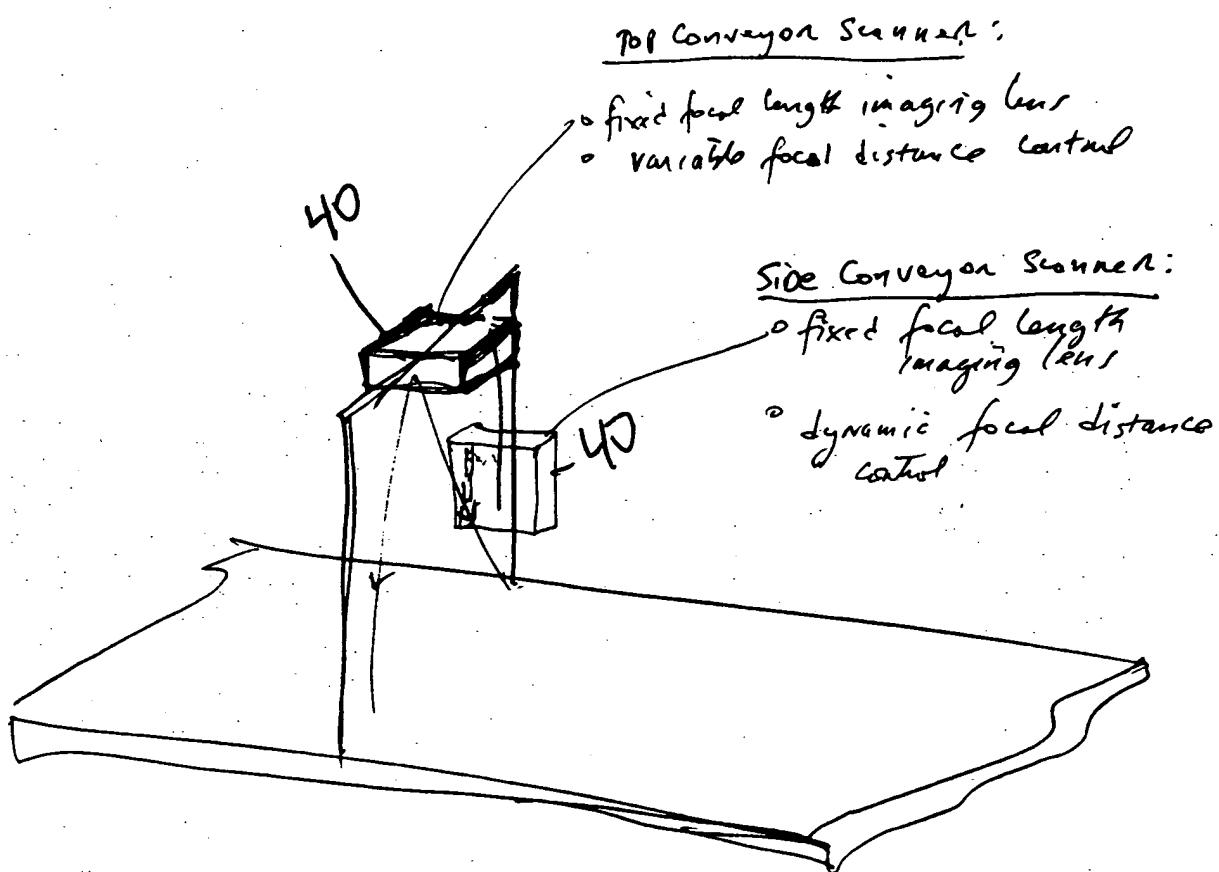


FIG. 2G

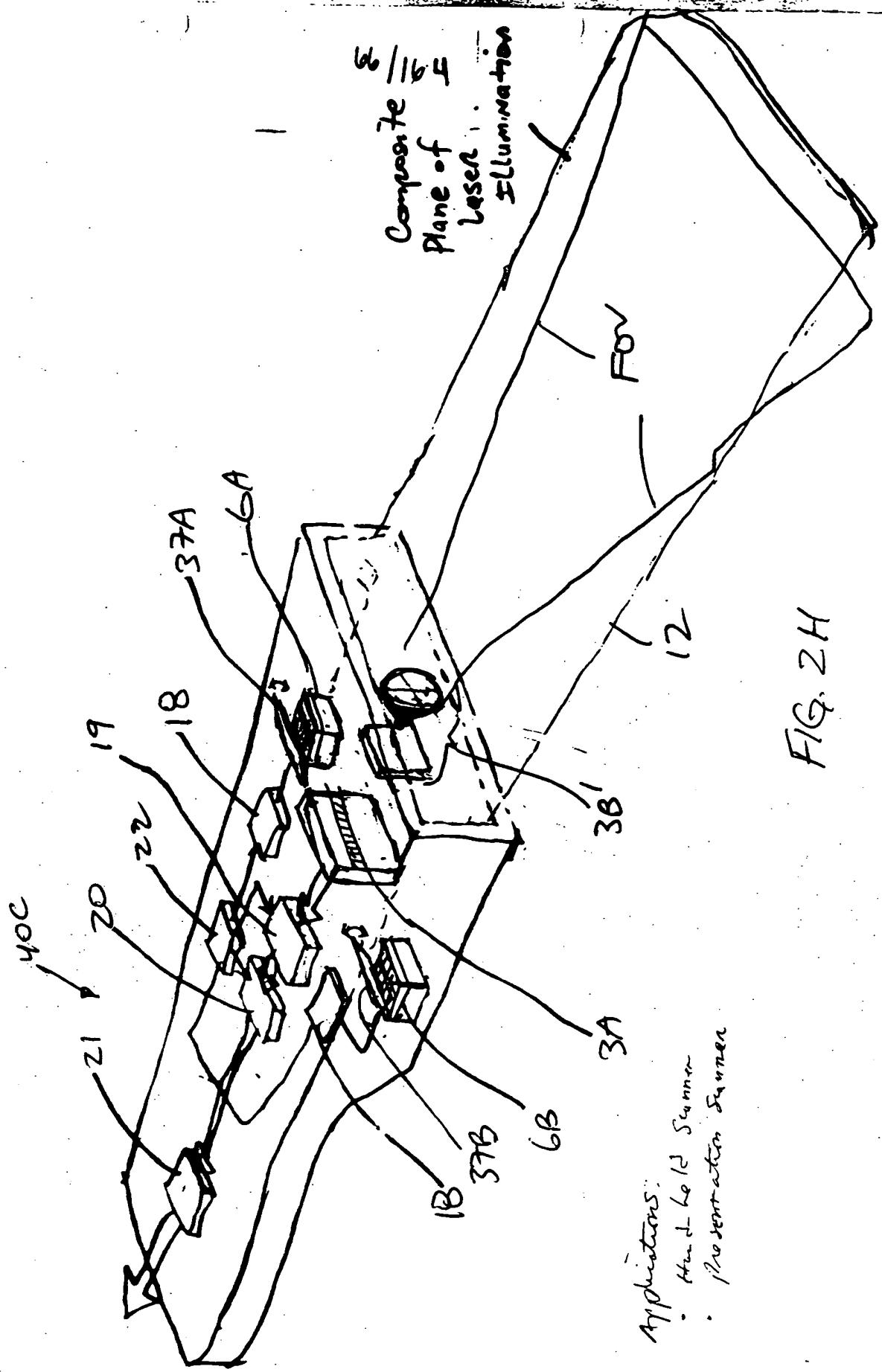


FIG. 2H

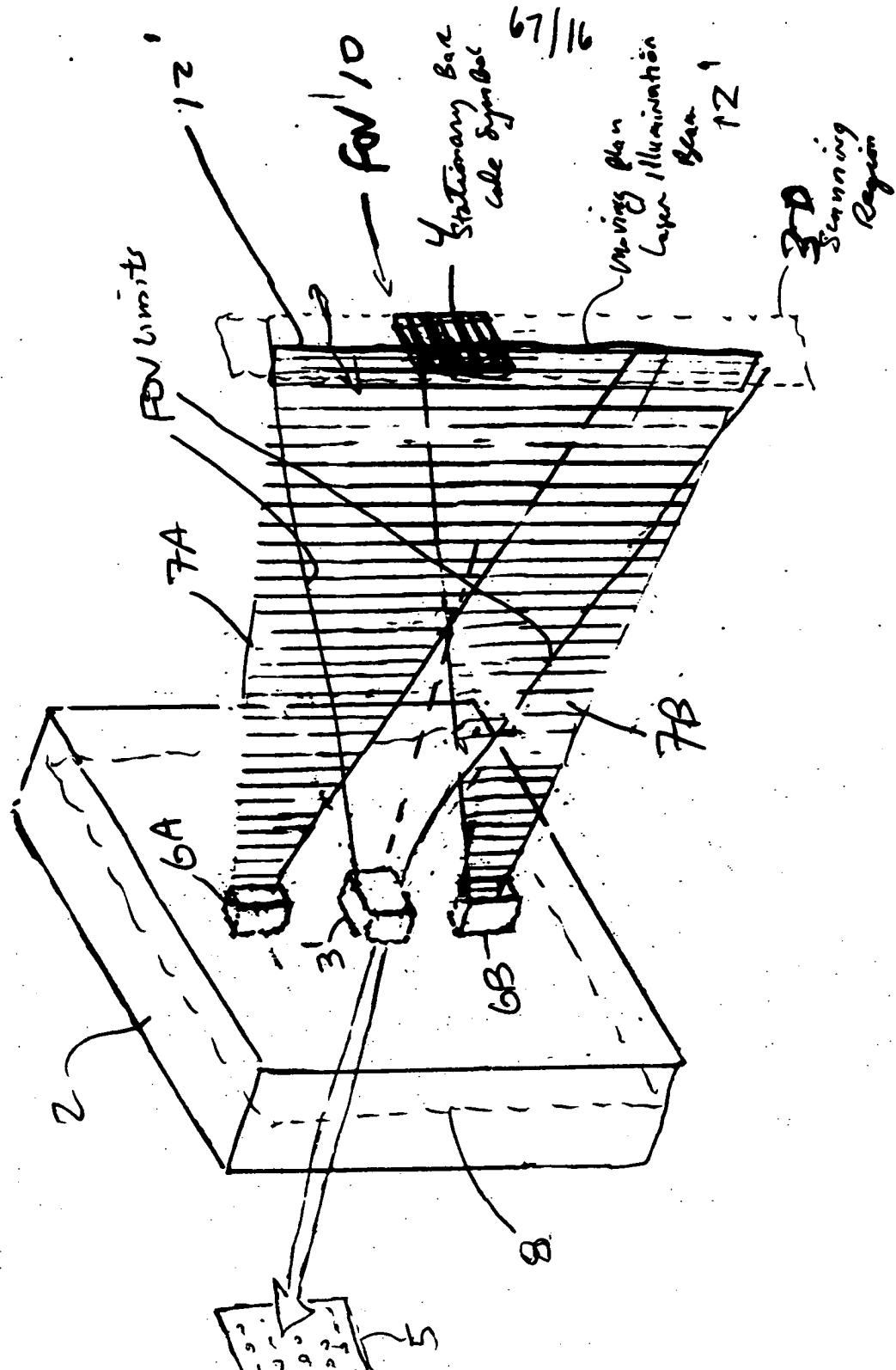
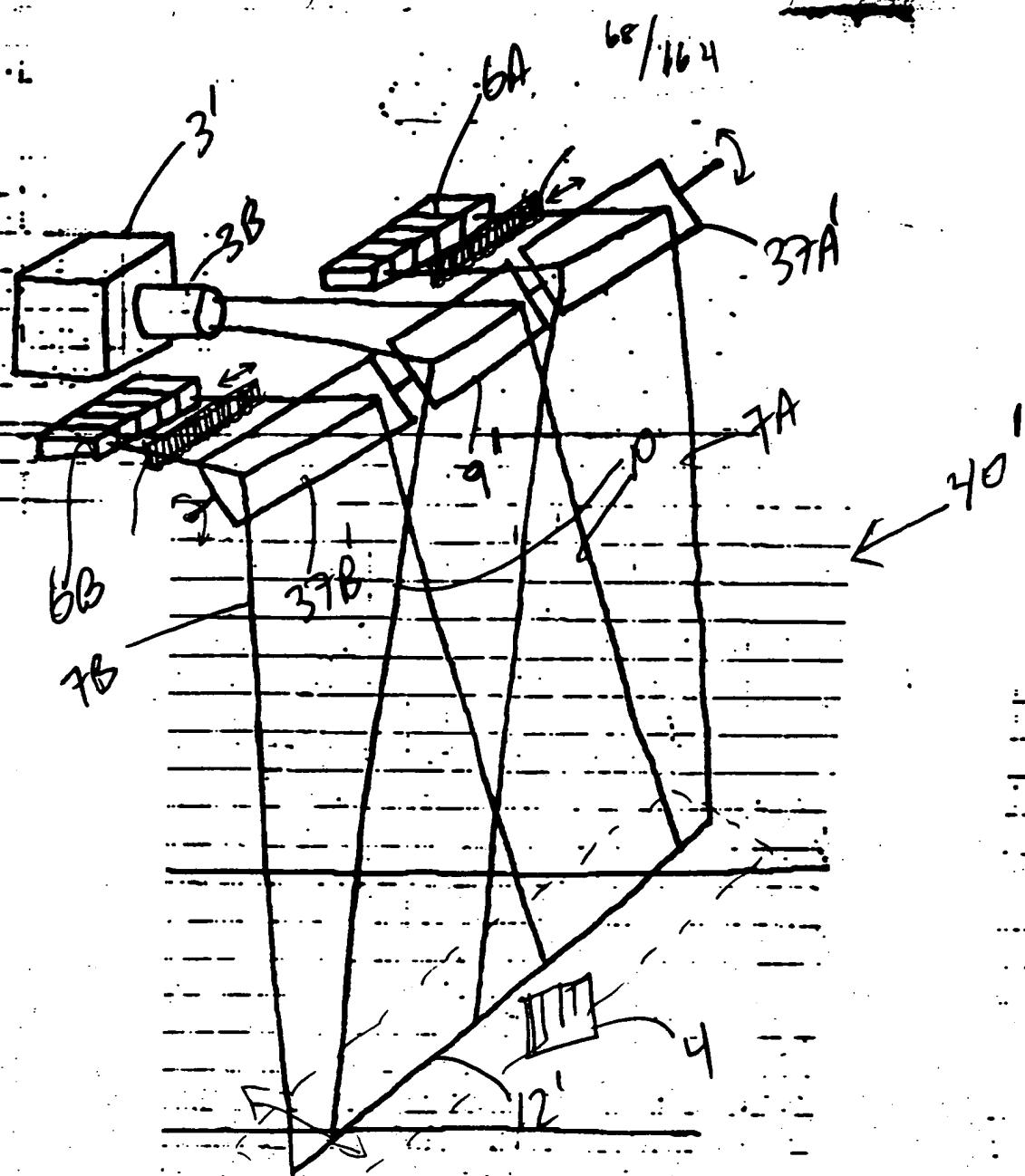


FIG. 2II



3-0
Examining
Report

FIG. 212

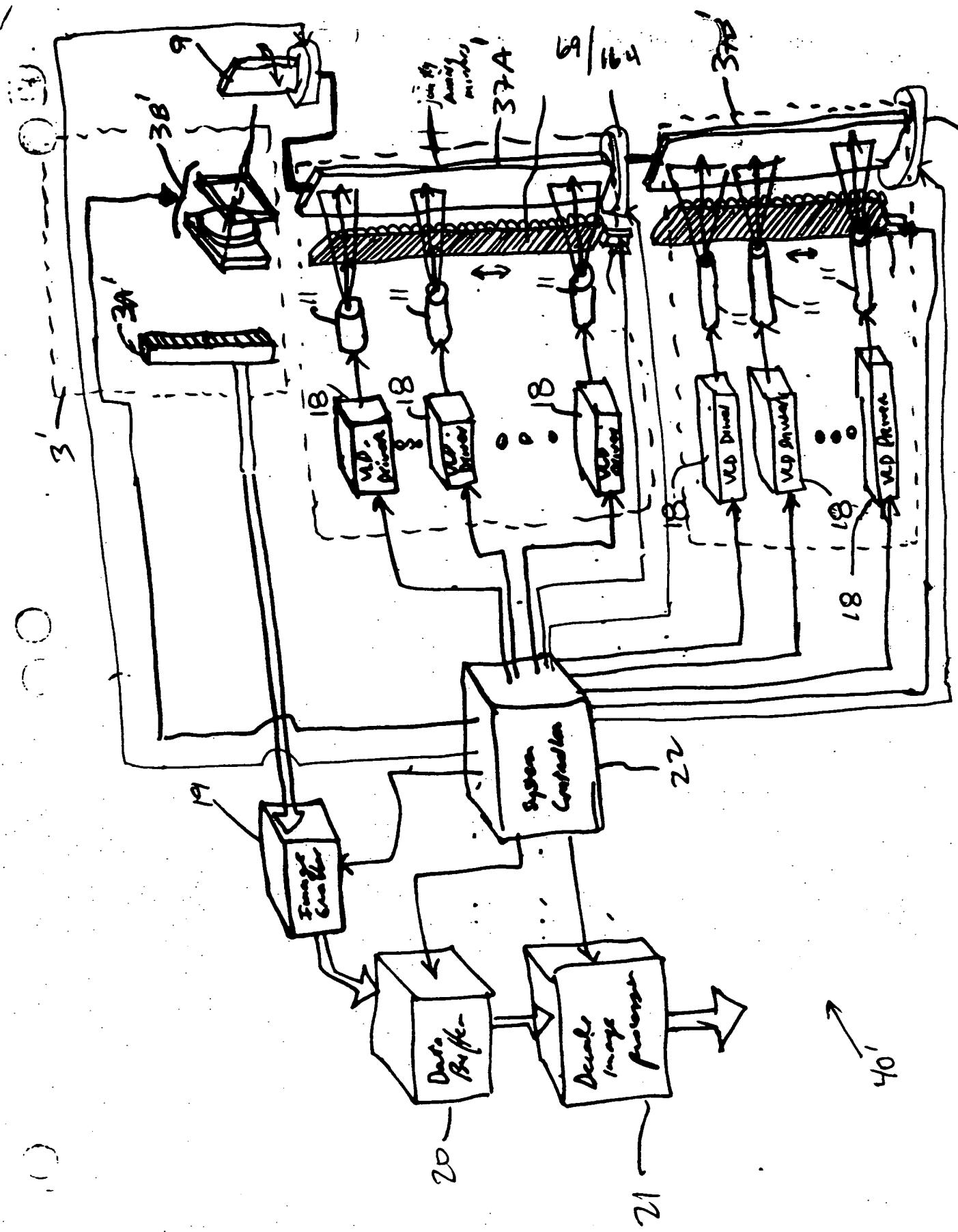


FIG. 2 T 3

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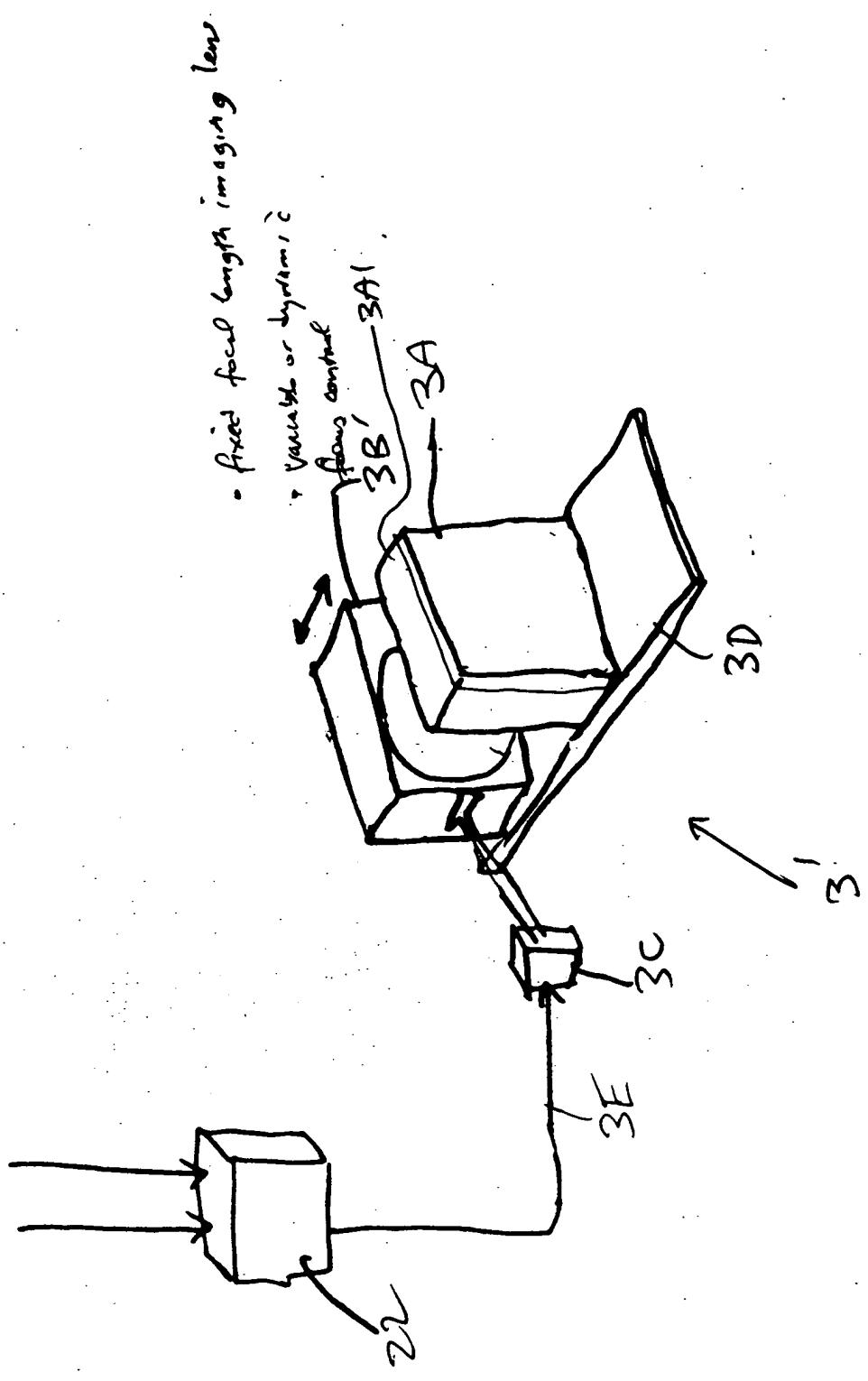
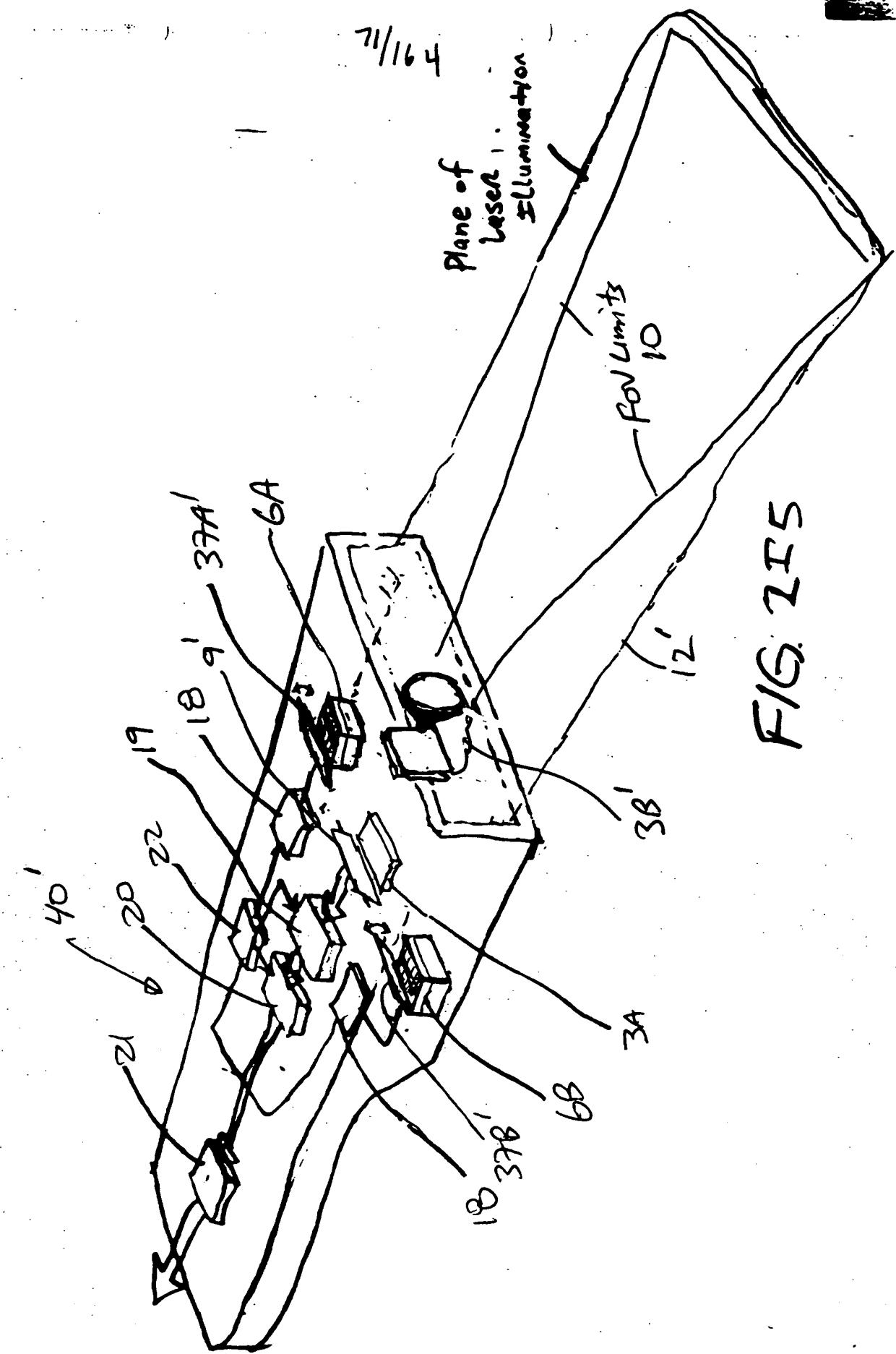


FIG. 2T4

FIG 215



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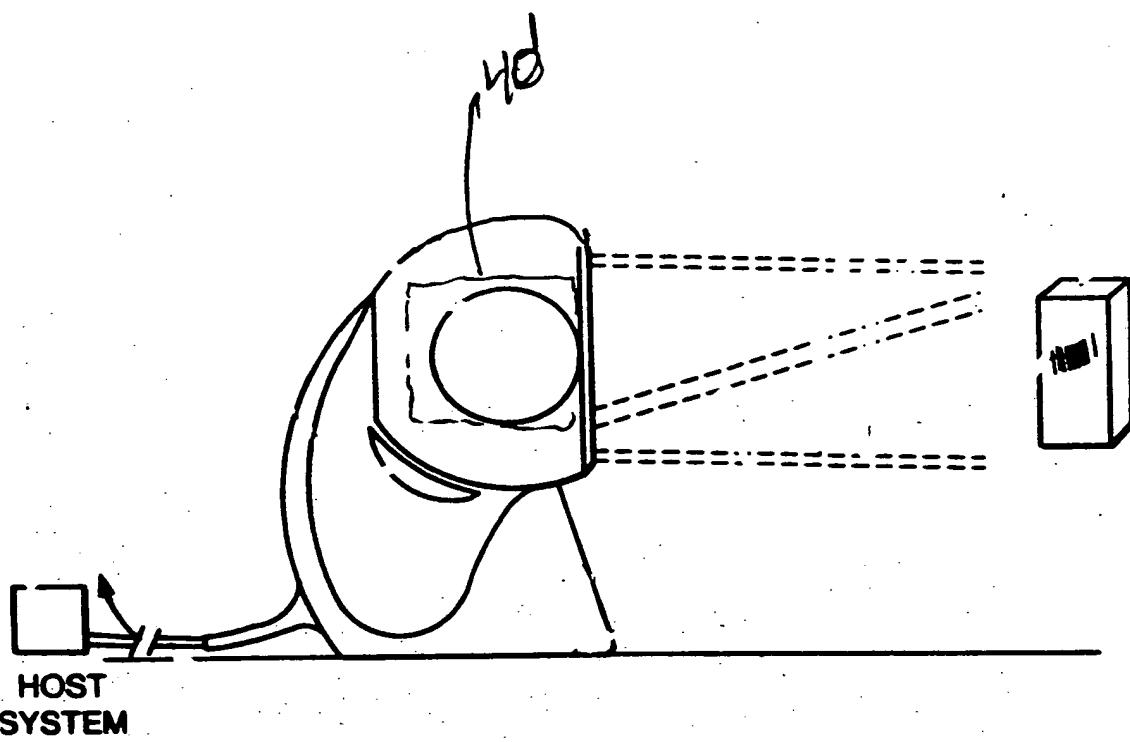
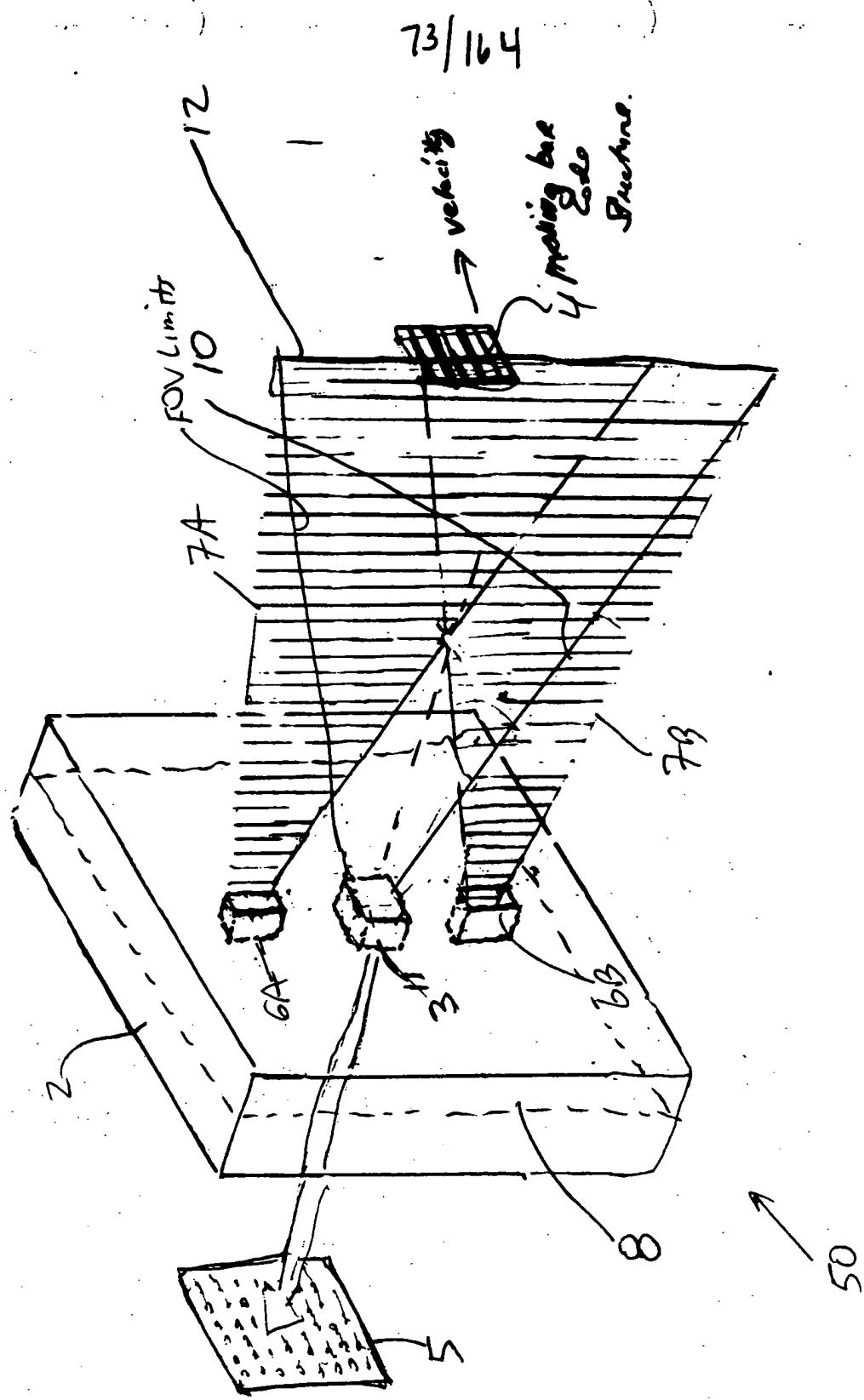


FIG. 2I6

FIG. 3A



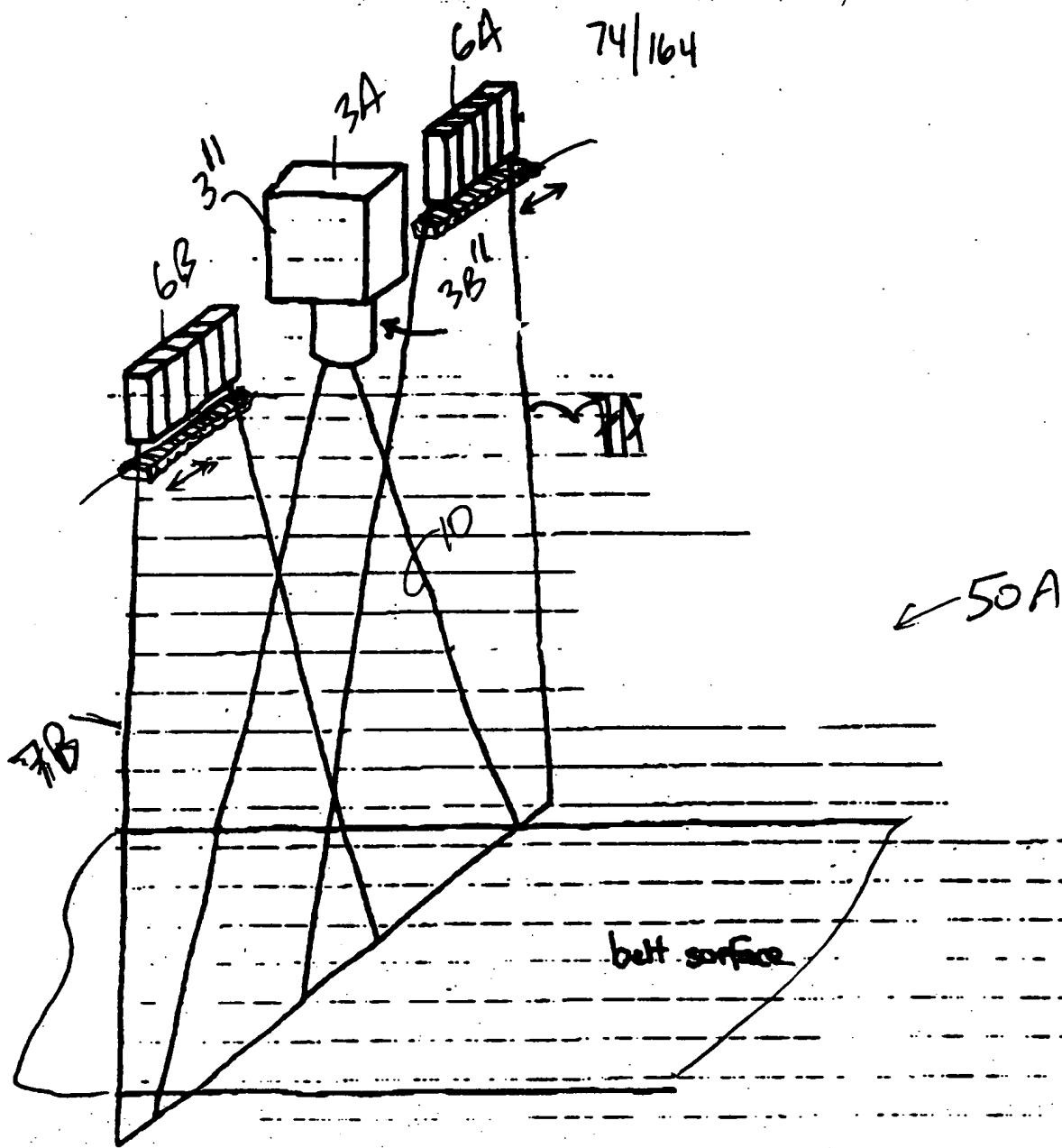


FIG.3B1

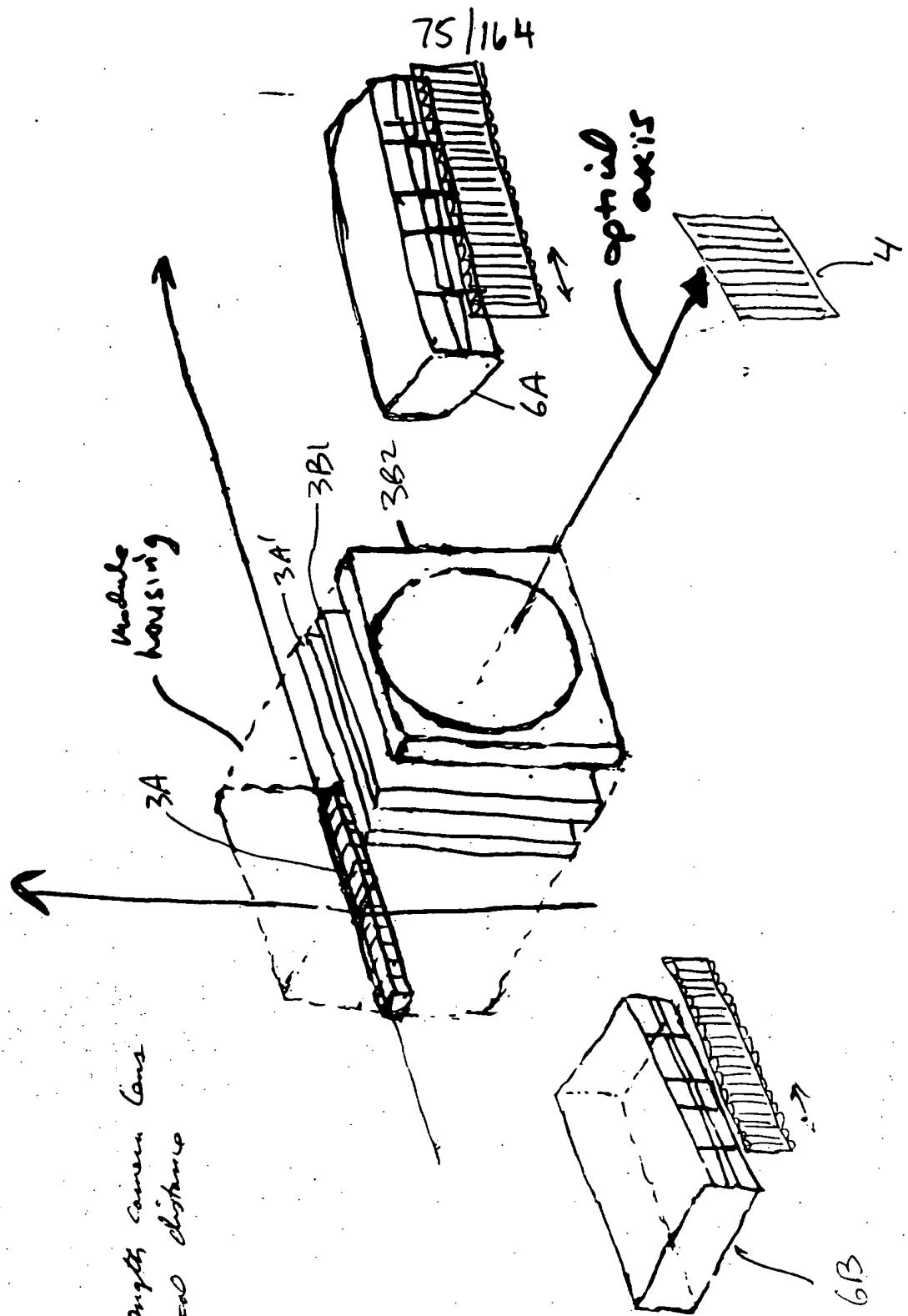


FIG. 3B2

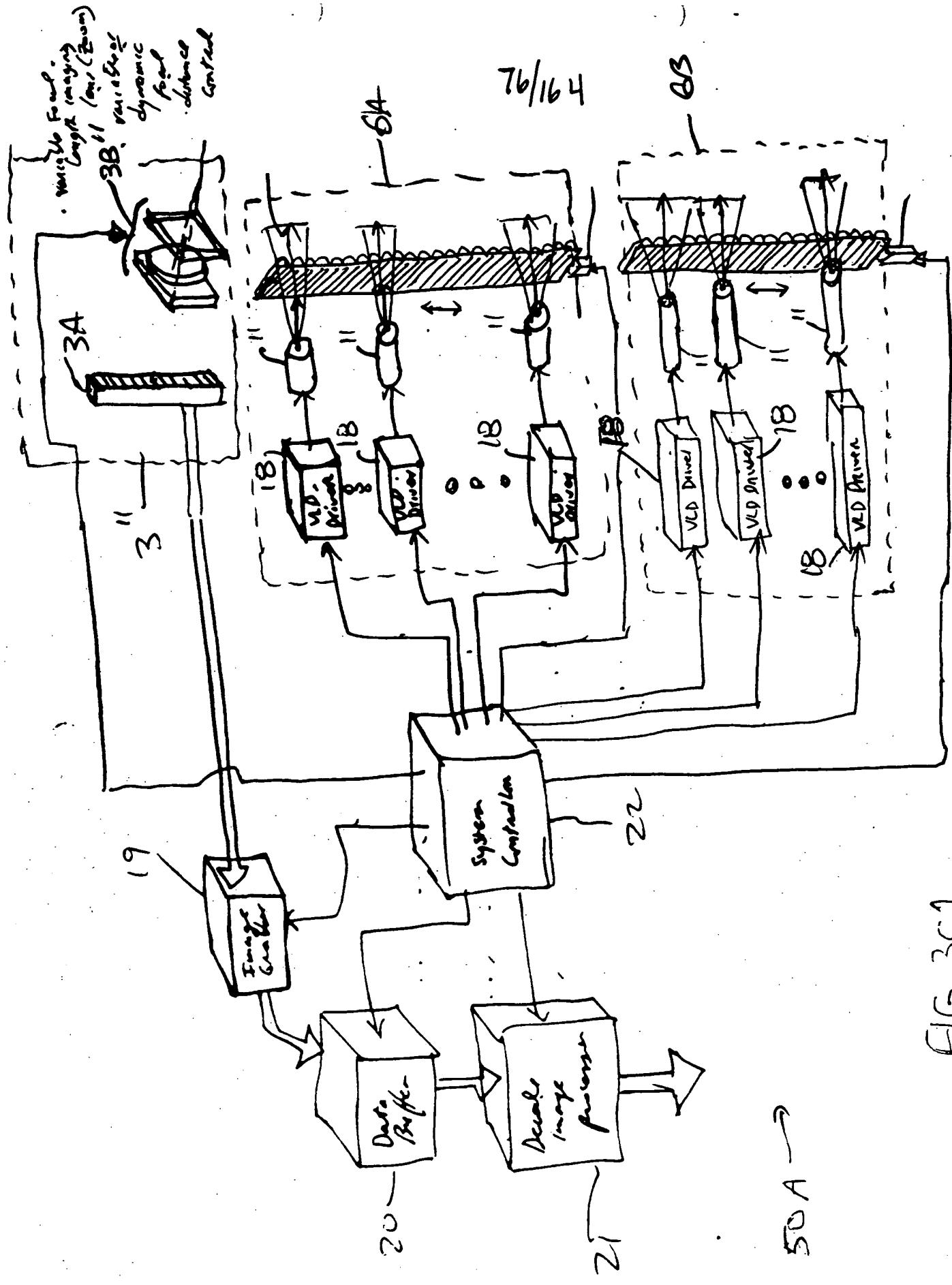


FIG 3C1

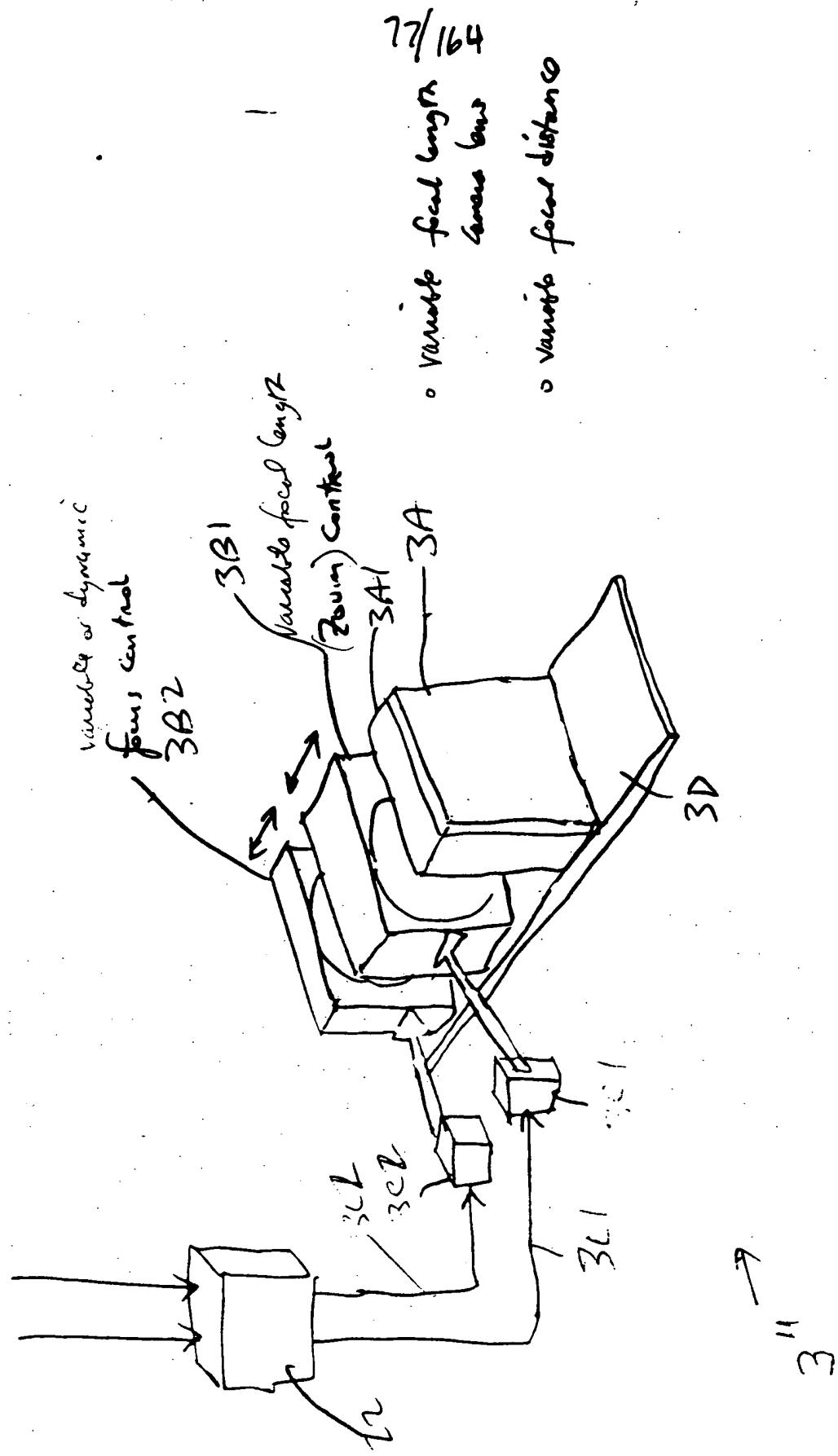


FIG. 3C2

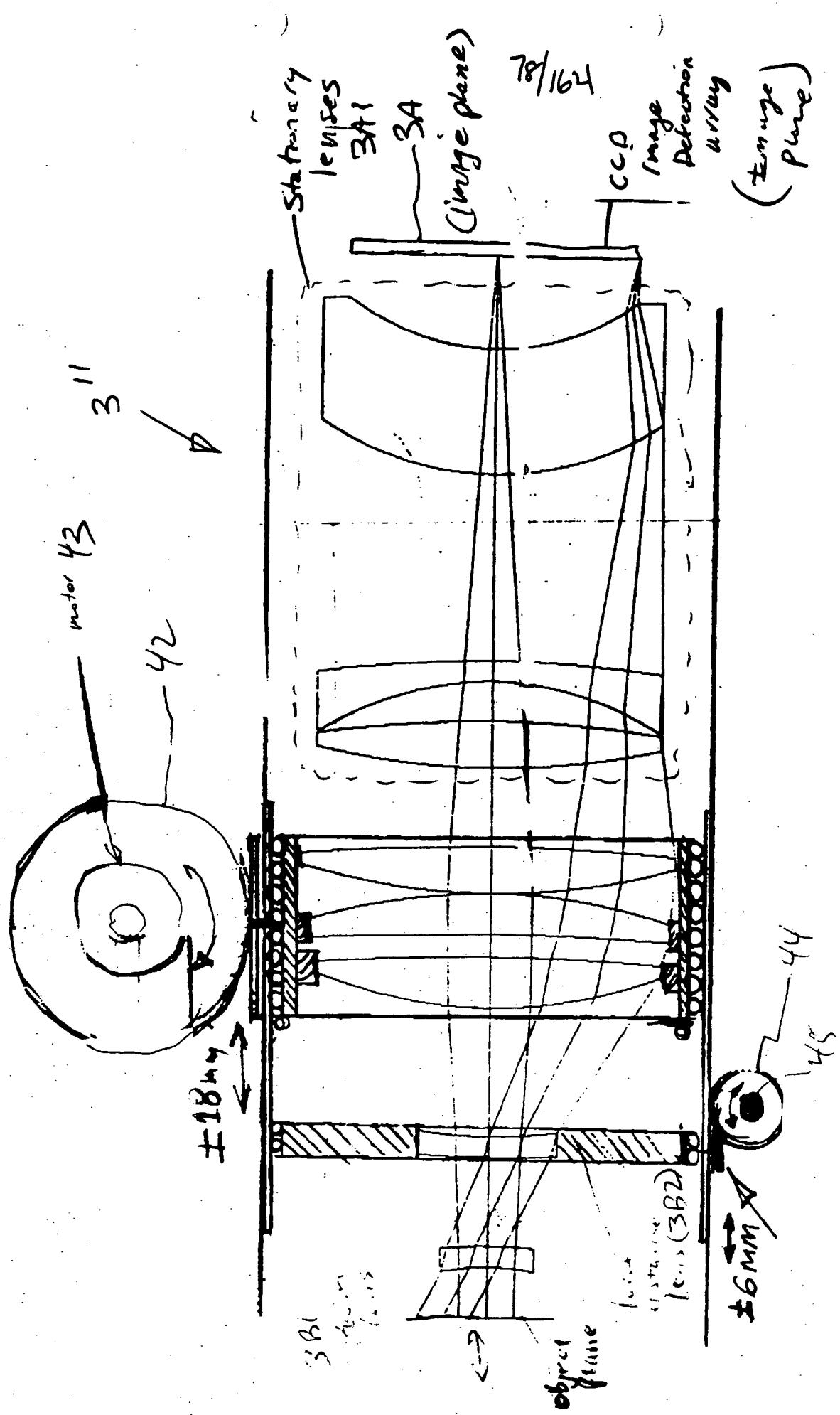
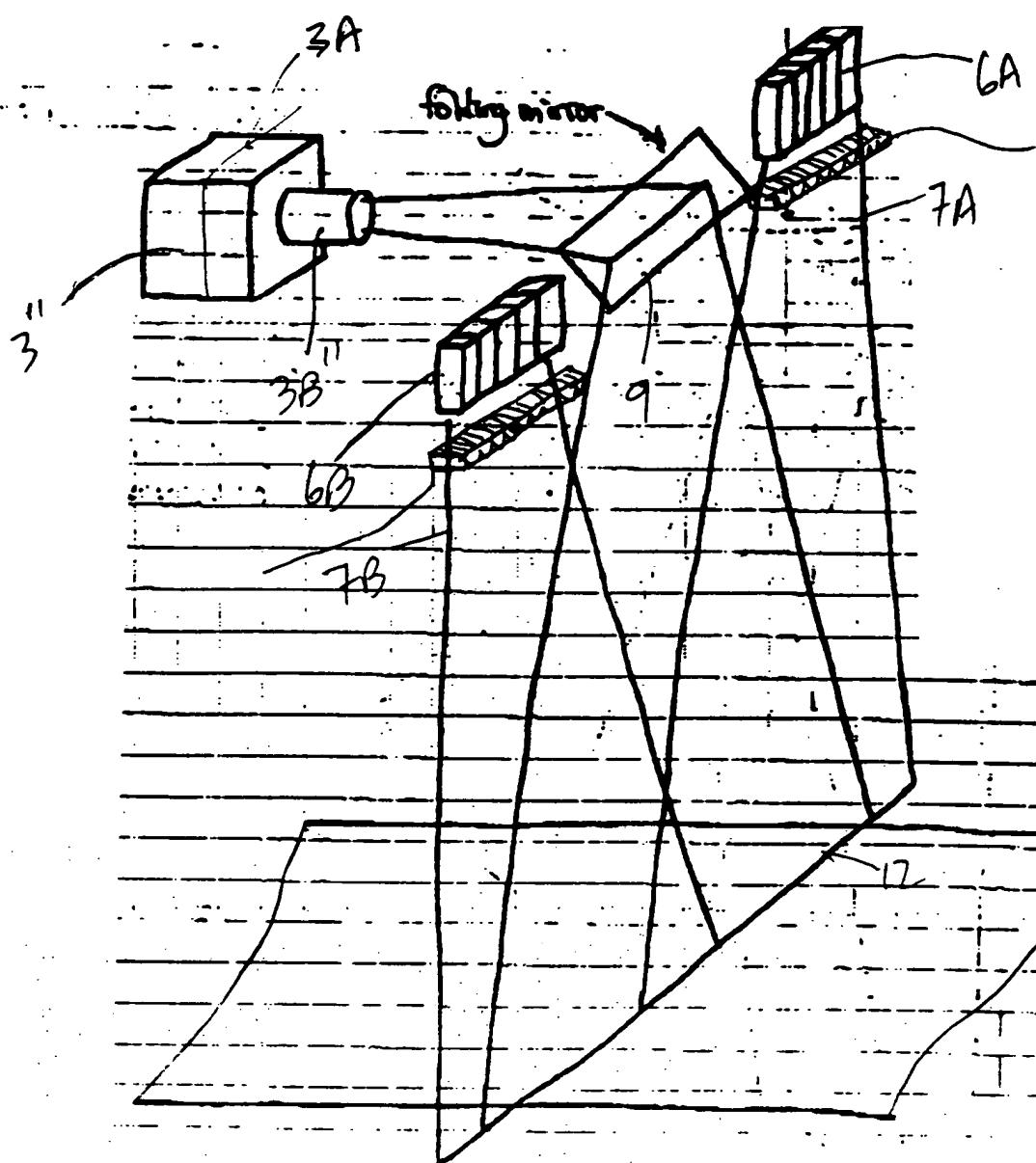


FIG. 3D

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SCG

FIG. 3E1

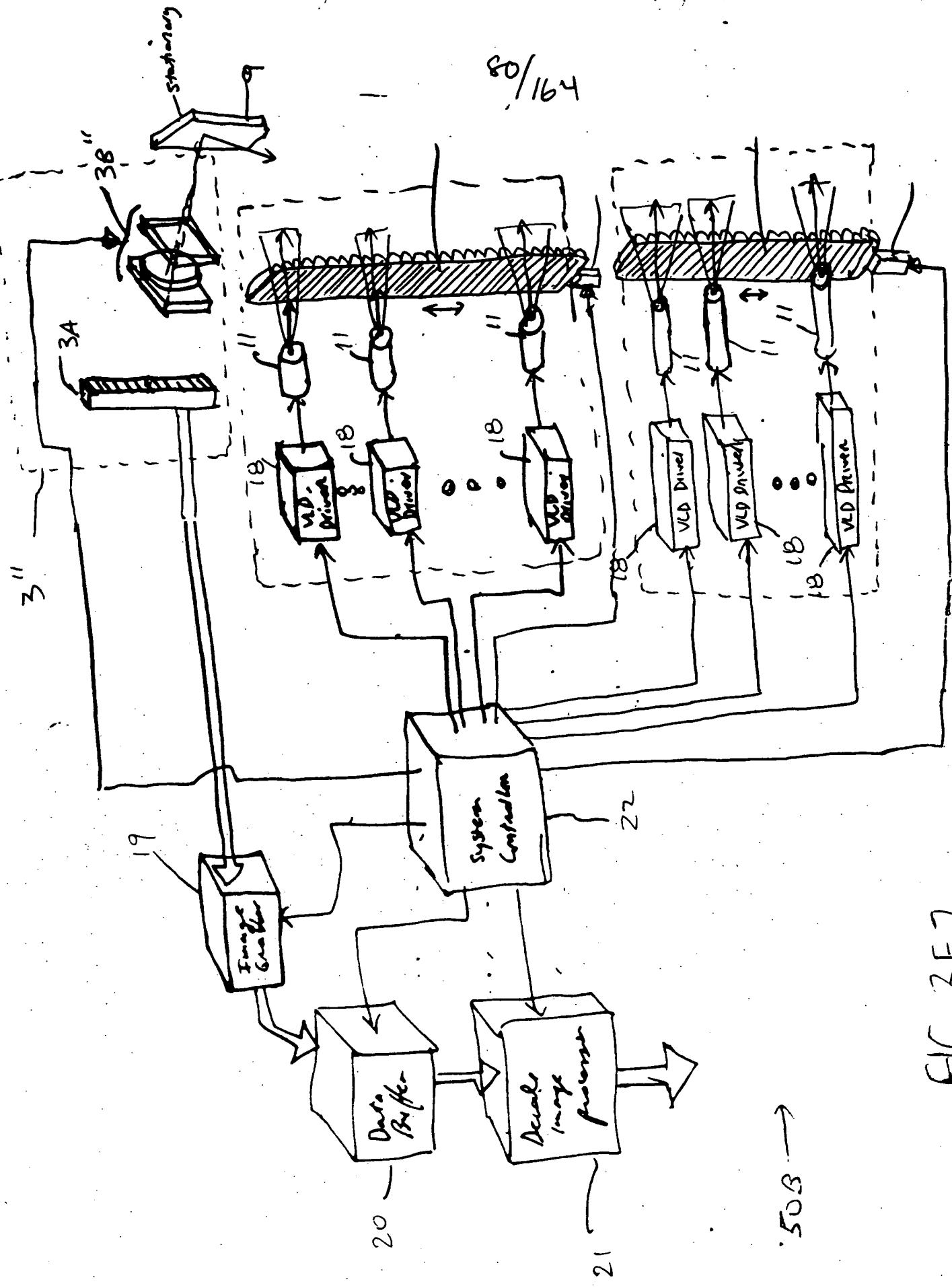


FIG. 2E2

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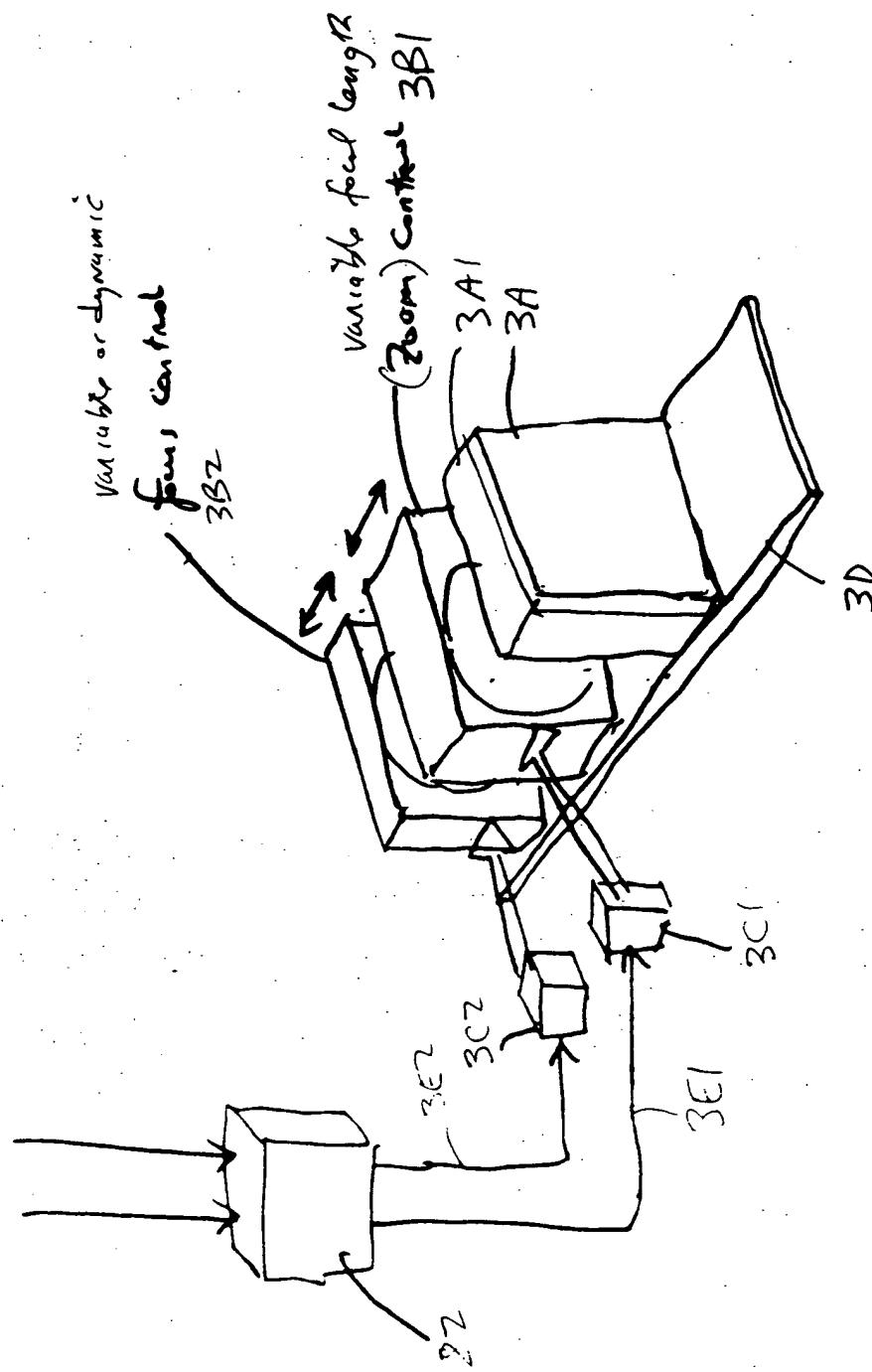


FIG. 3E3

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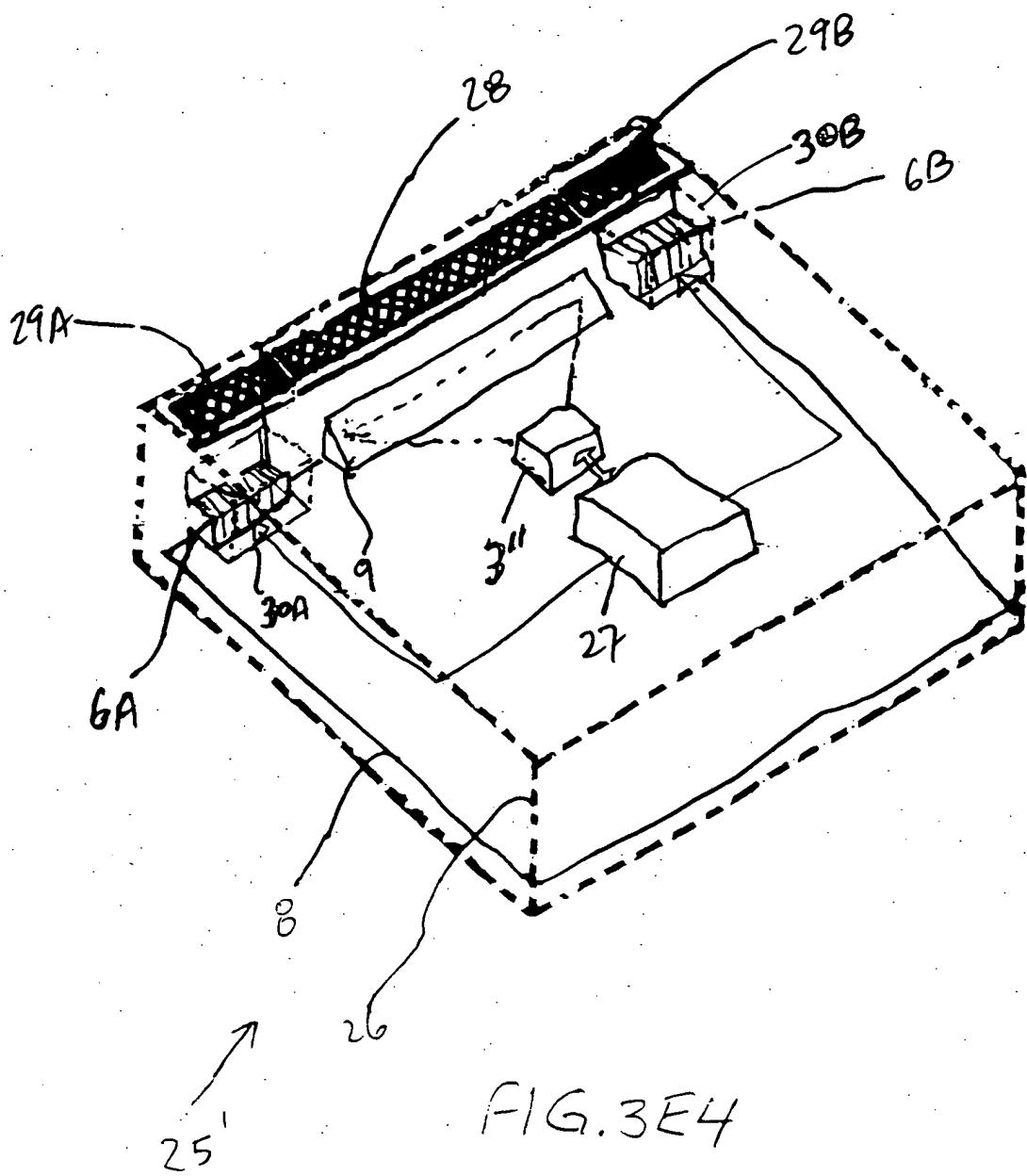


FIG. 3E4

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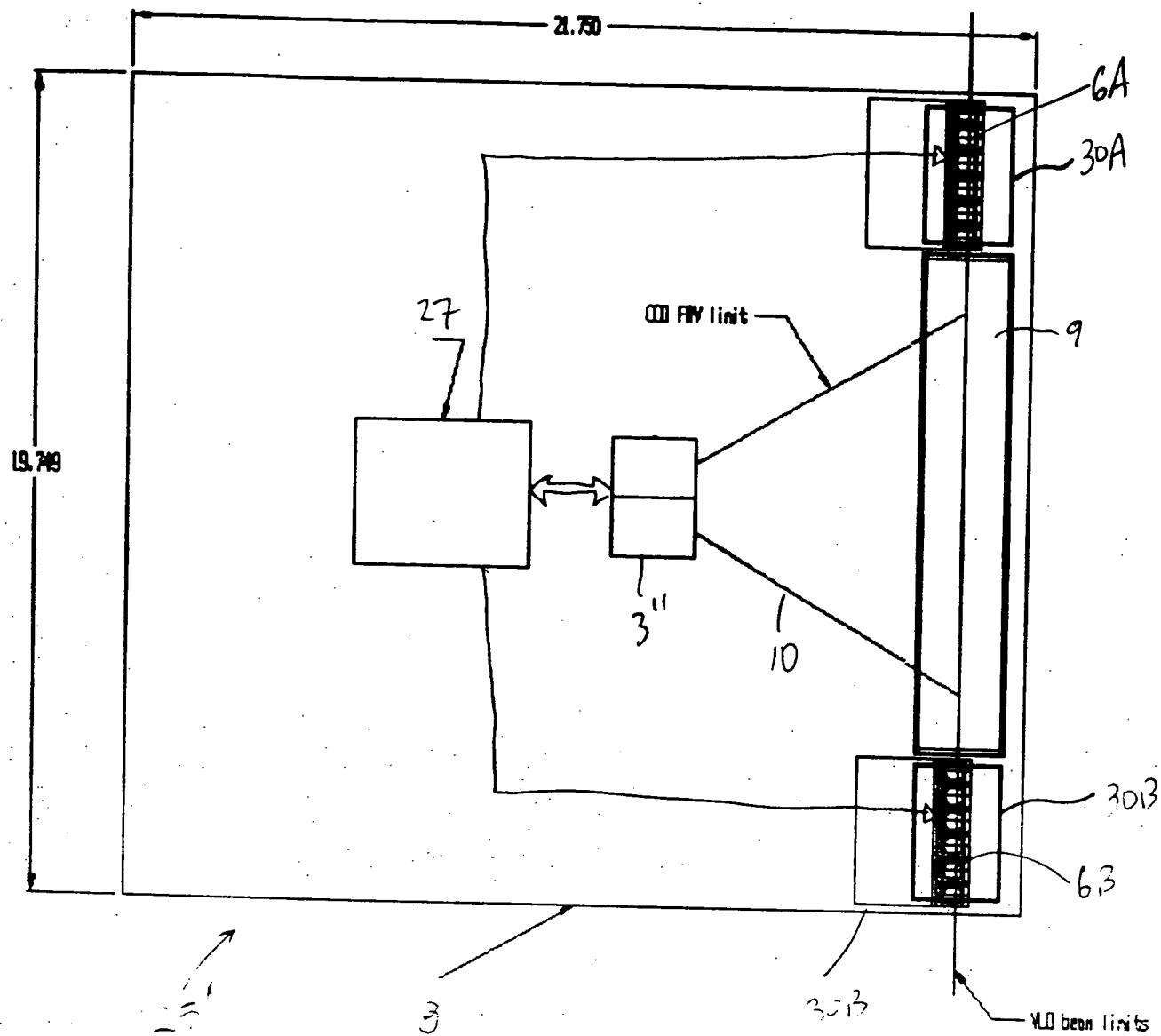


FIG. 3E5

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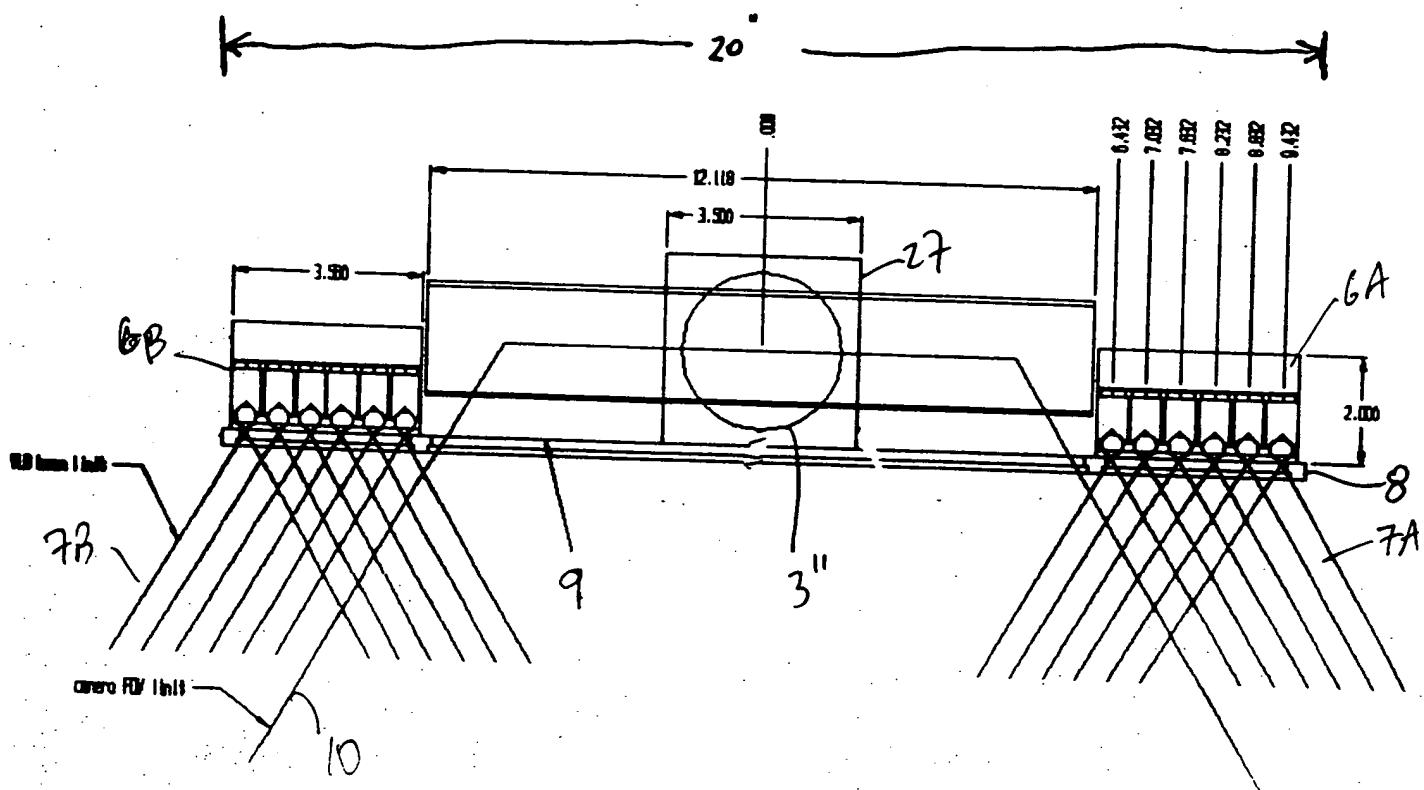


FIG. 3E6

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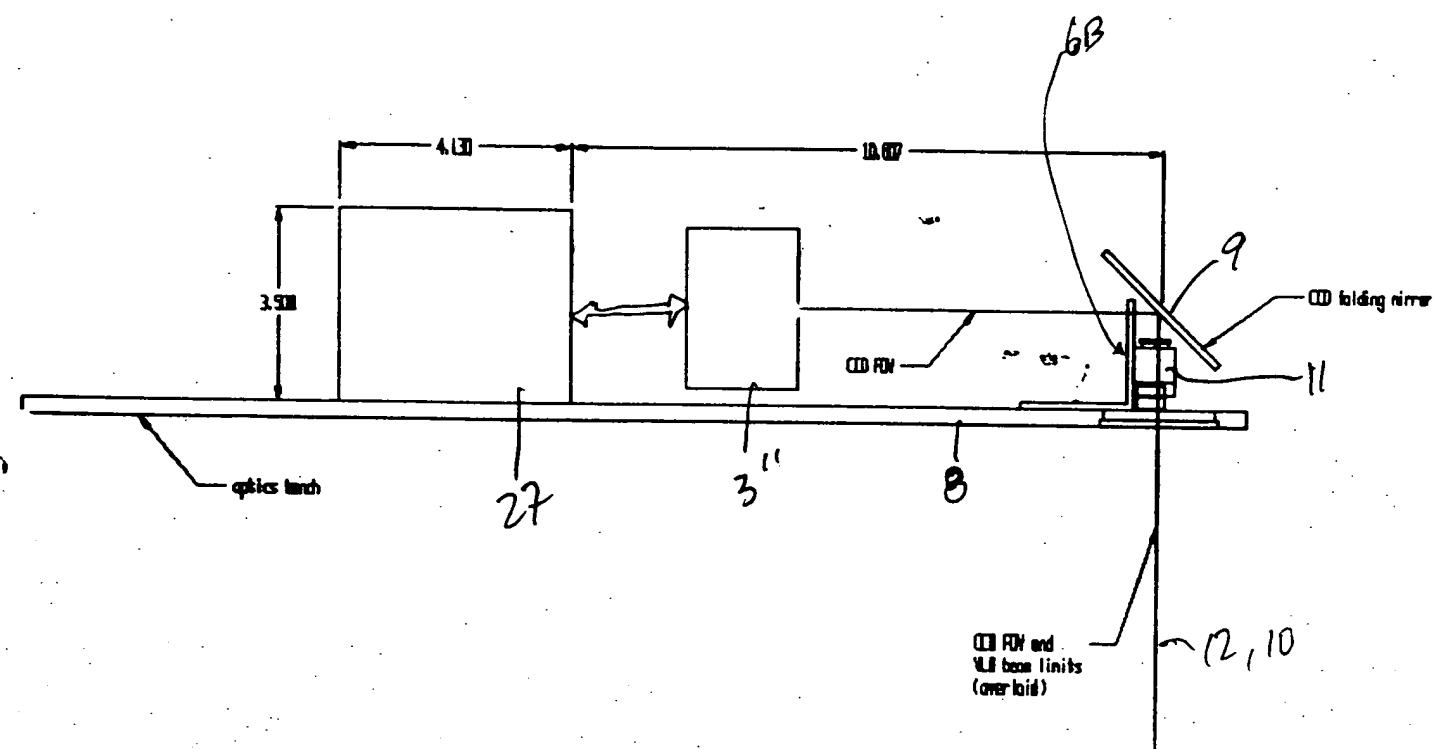


FIG 3E7

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* Variable FOV

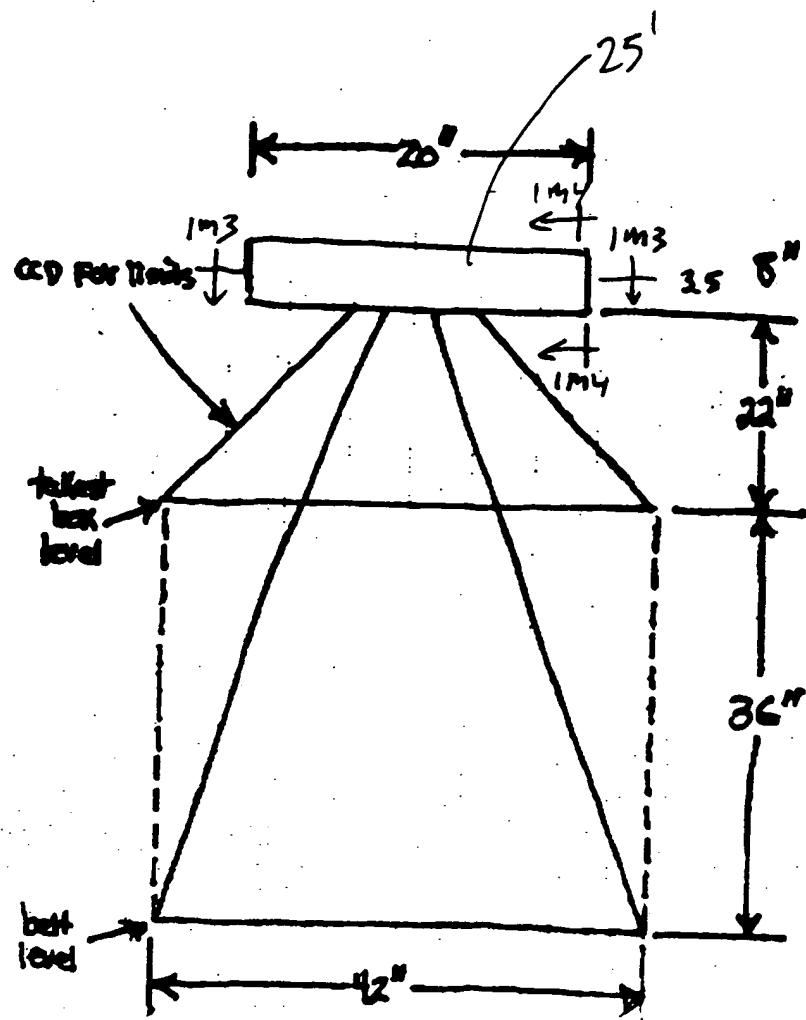


FIG. 3E8

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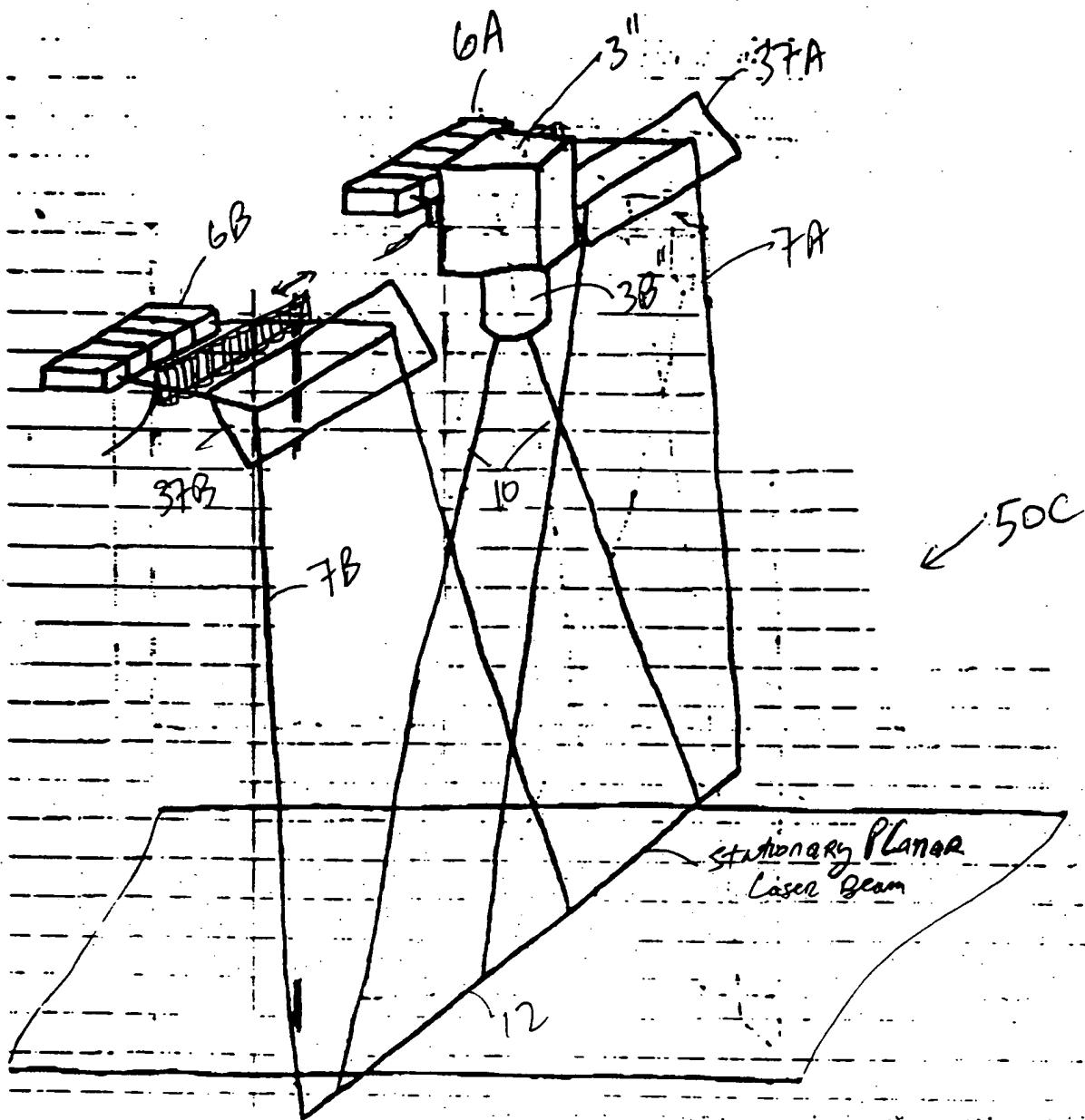
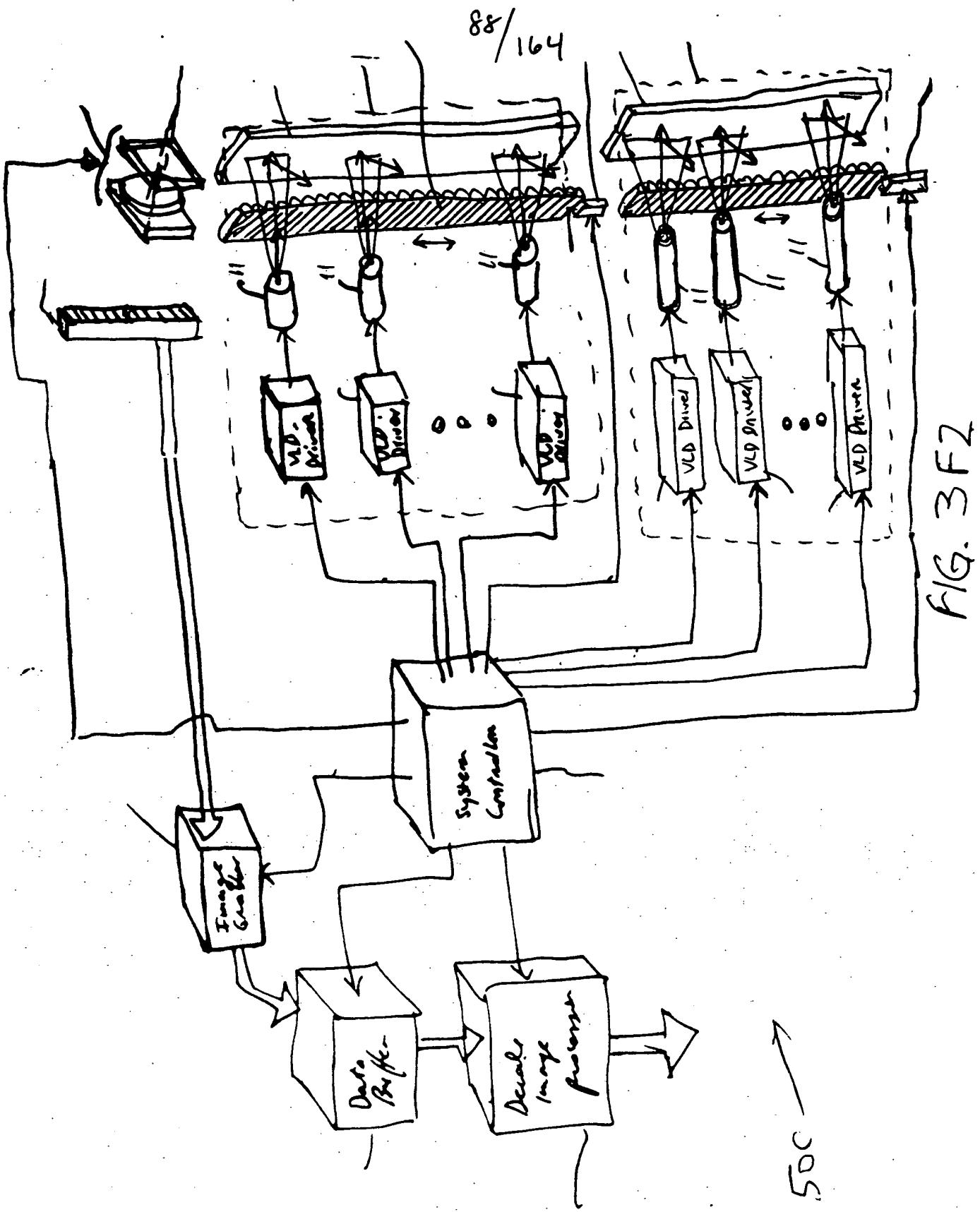


FIG. 3F1



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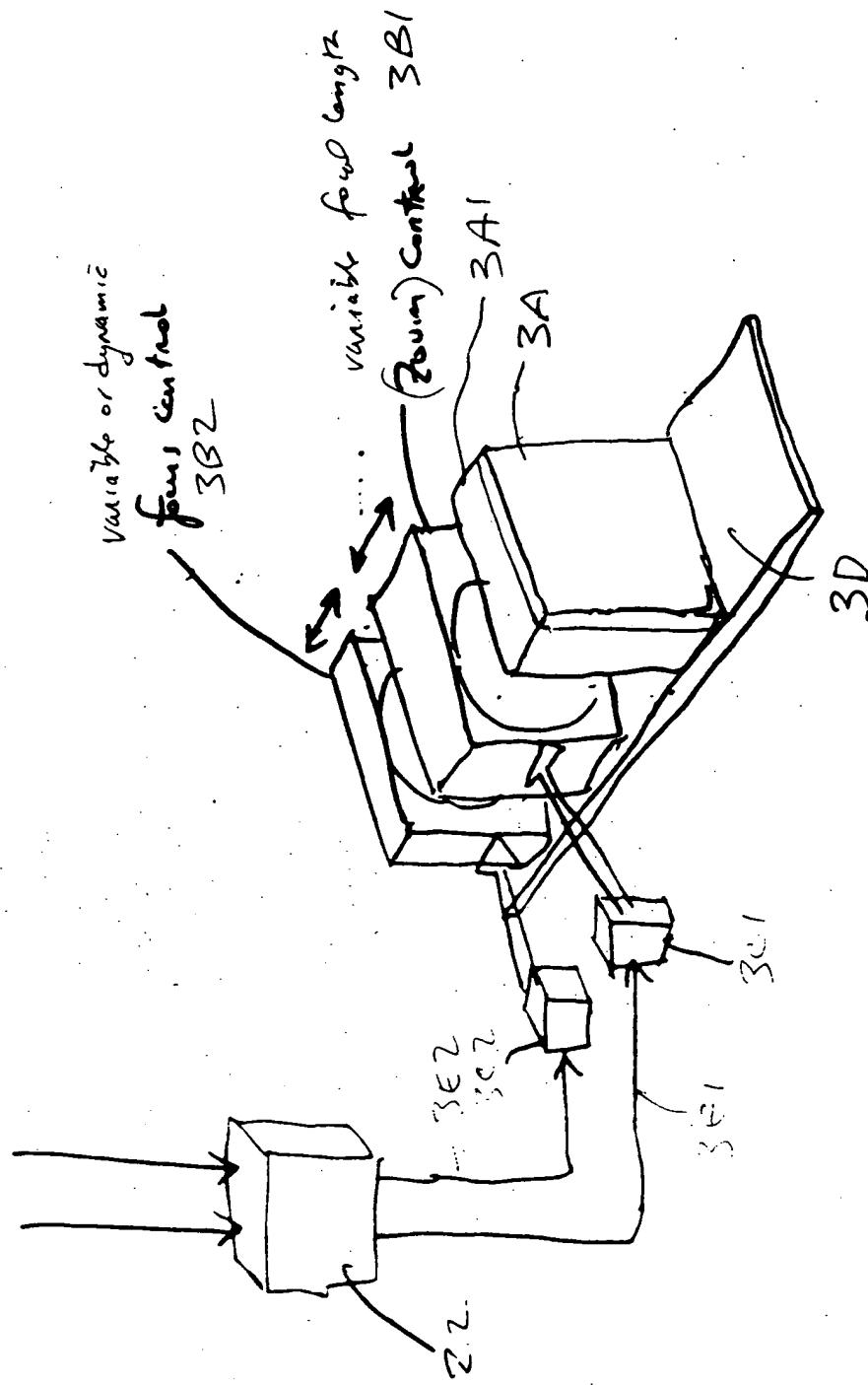


FIG. 3F3

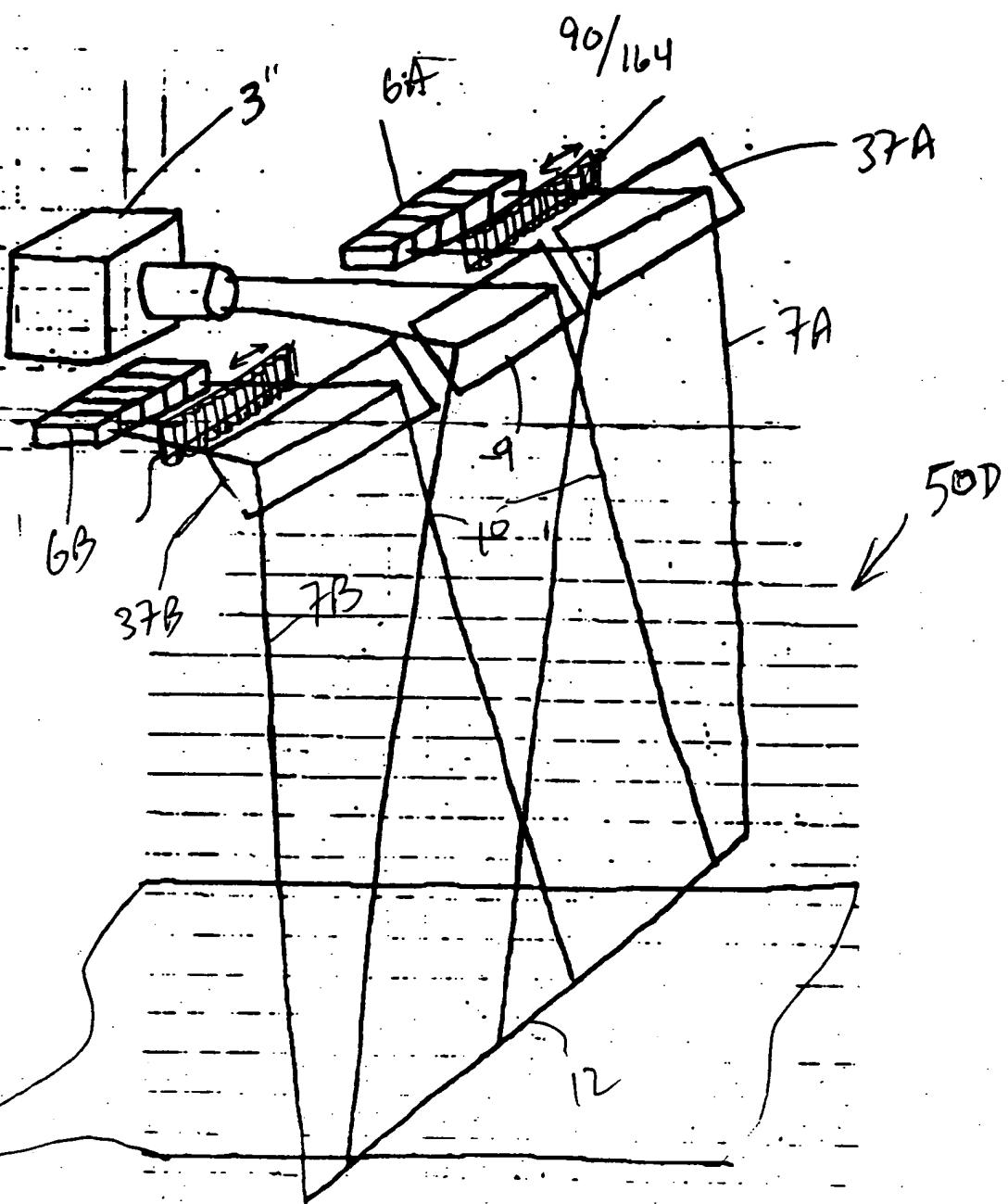
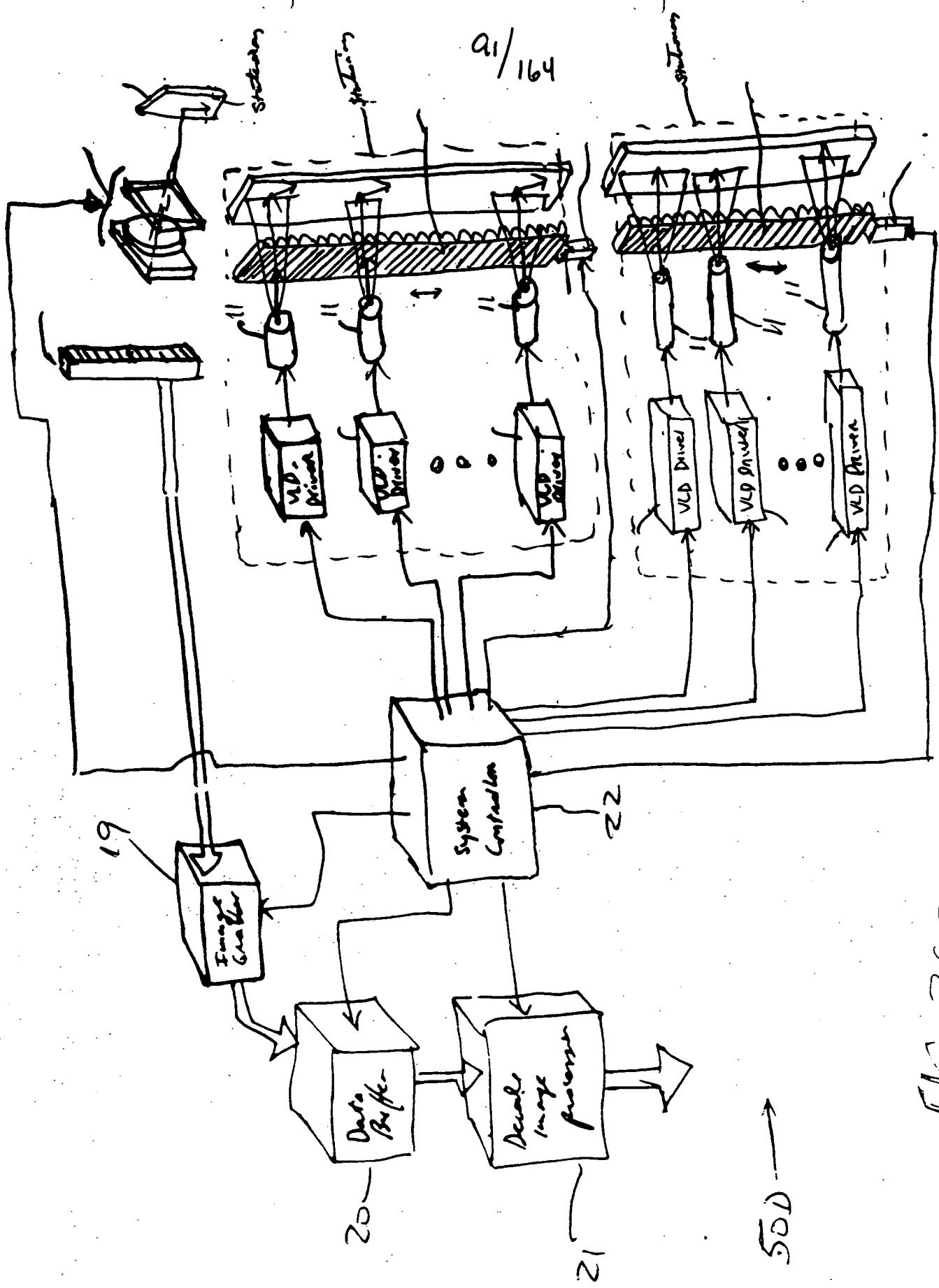


FIG. 3G1



FlG 3G2

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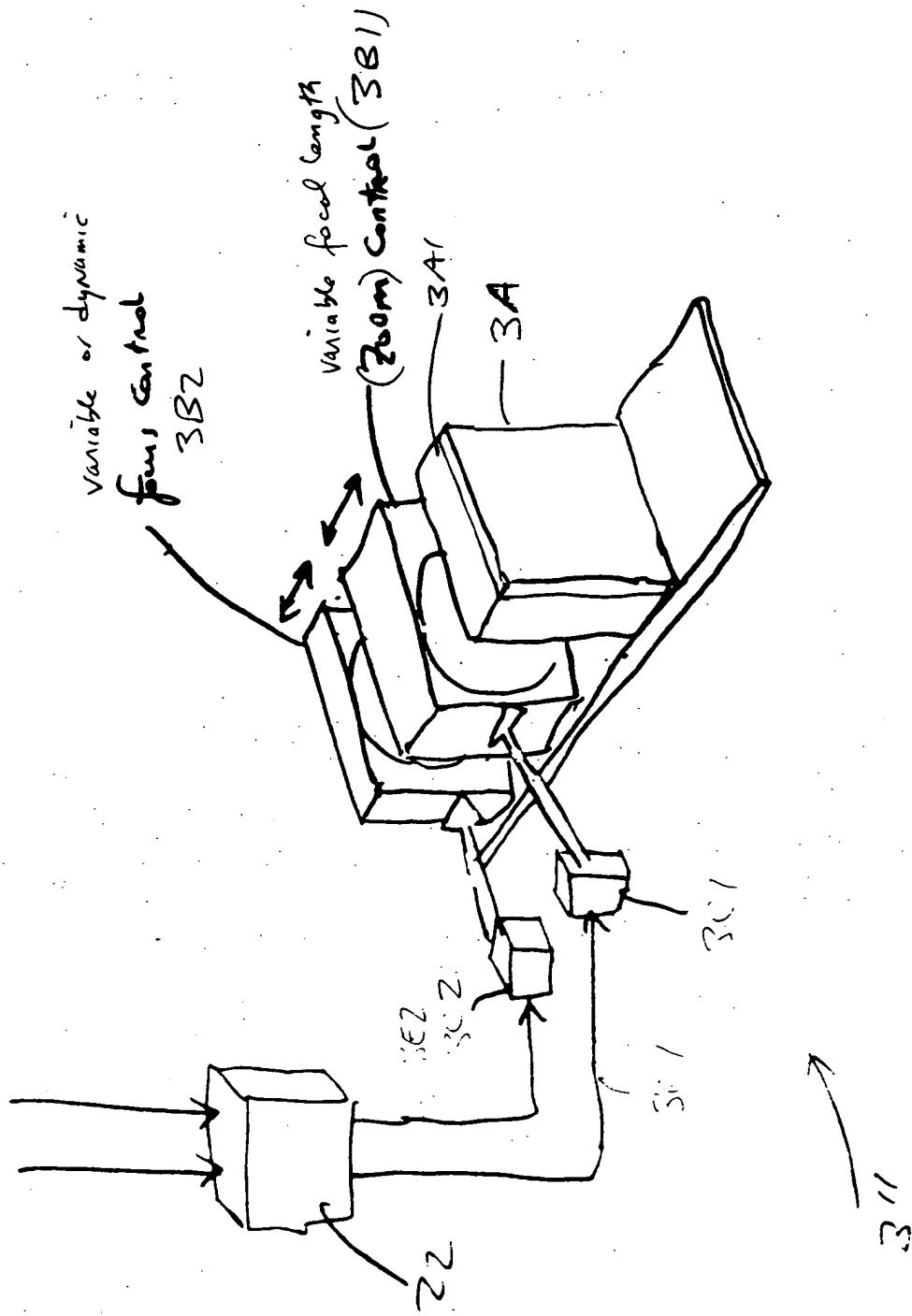


FIG. 3Q3

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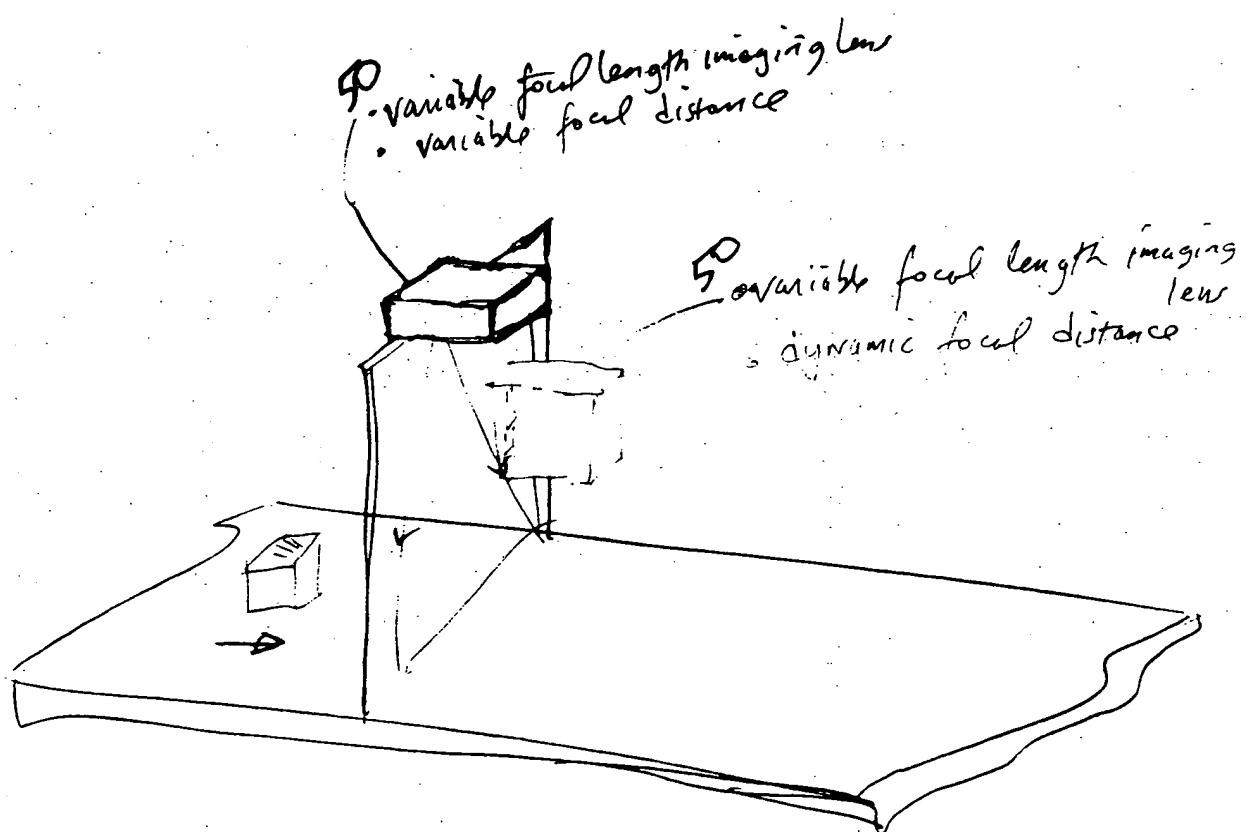
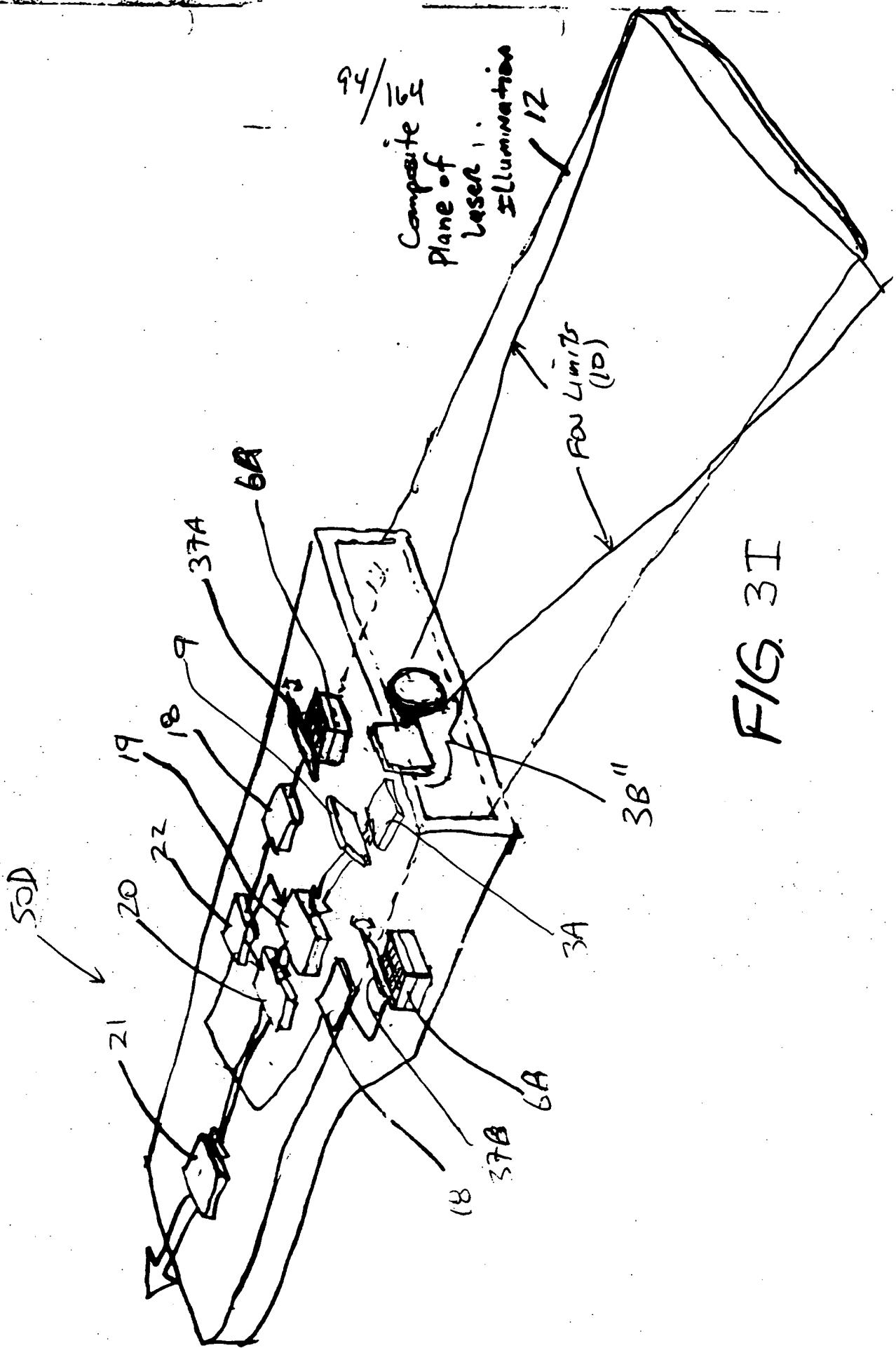


FIG. 3H



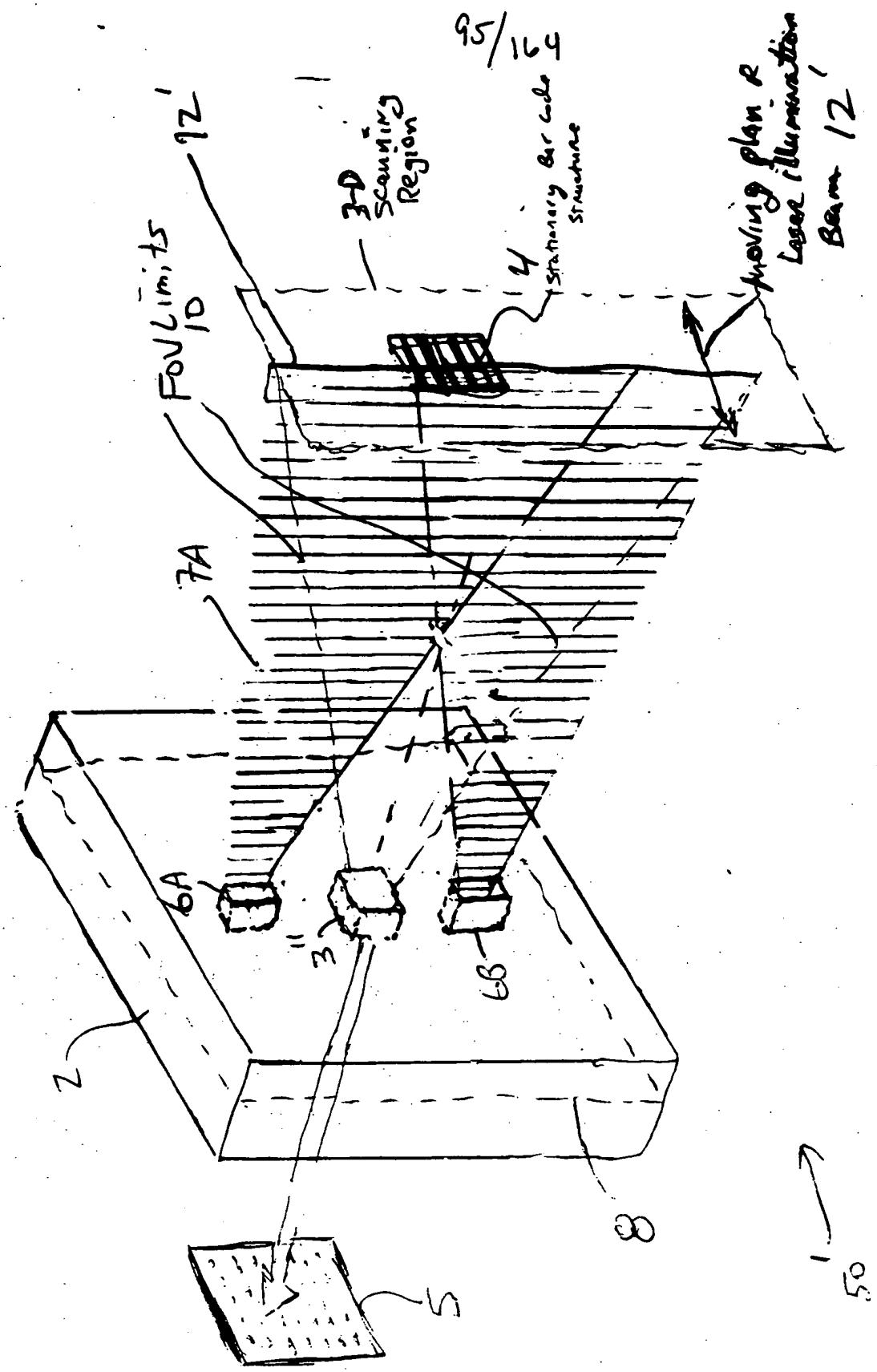


FIG. 351

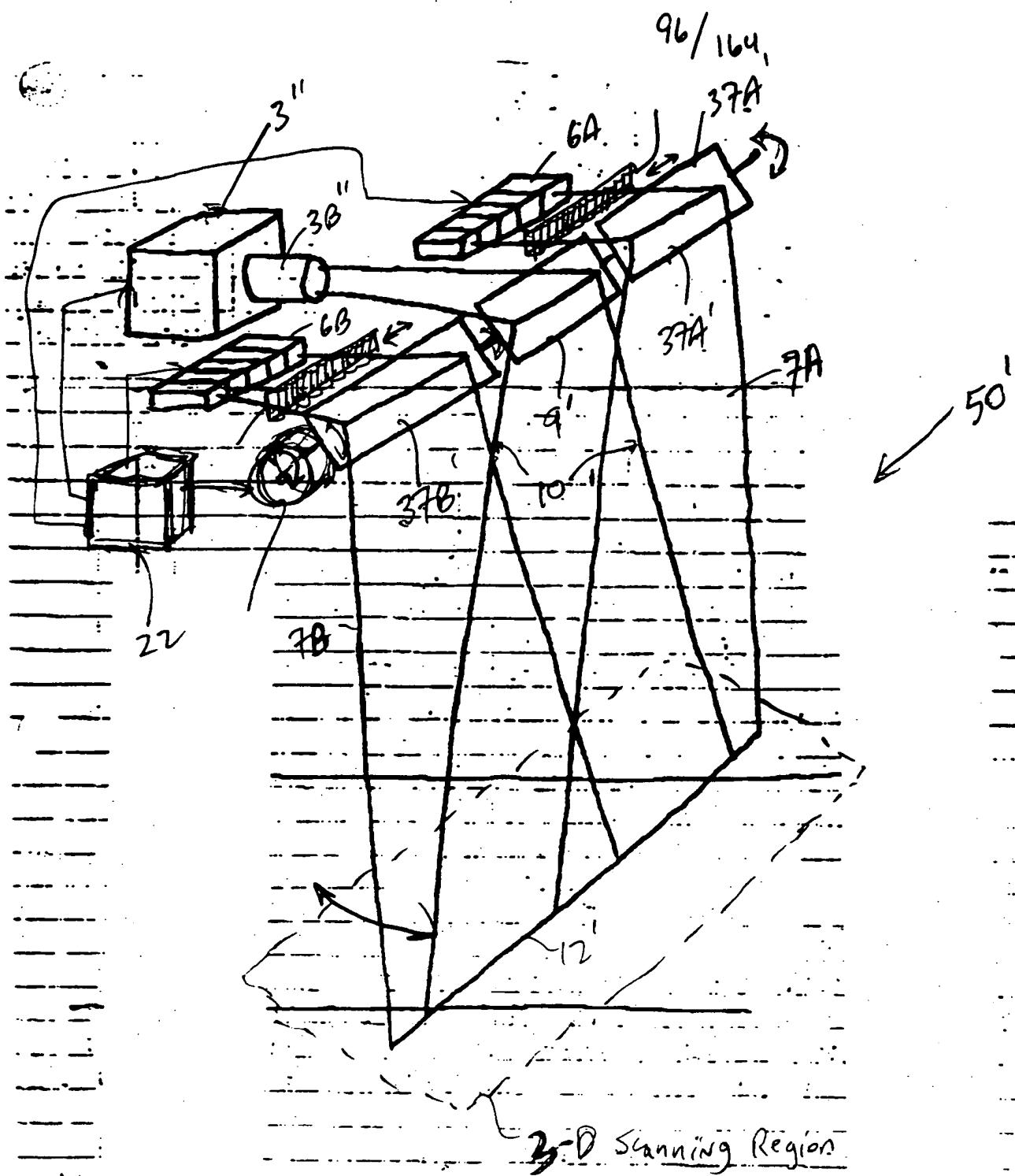
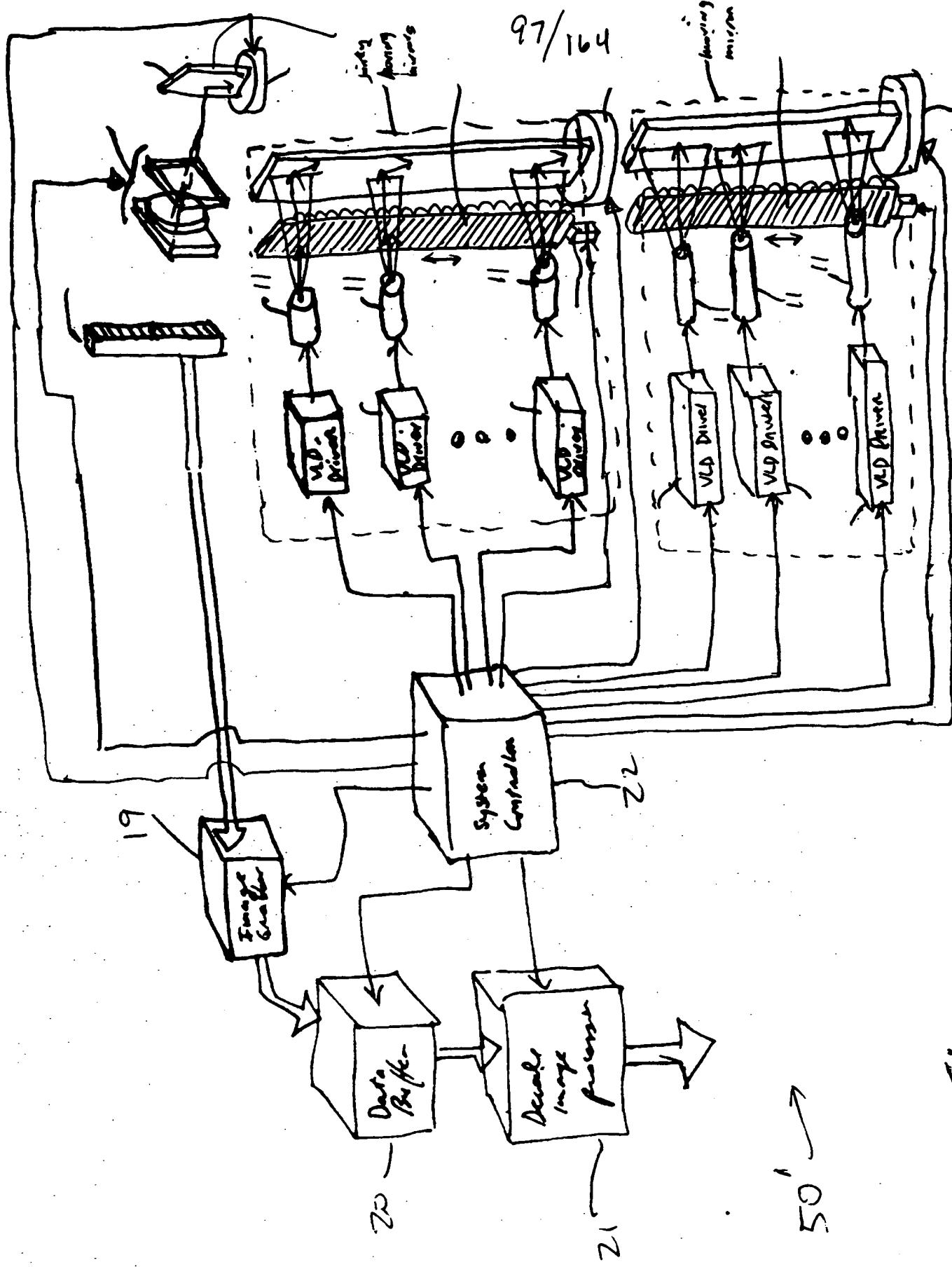


FIG. 3J2



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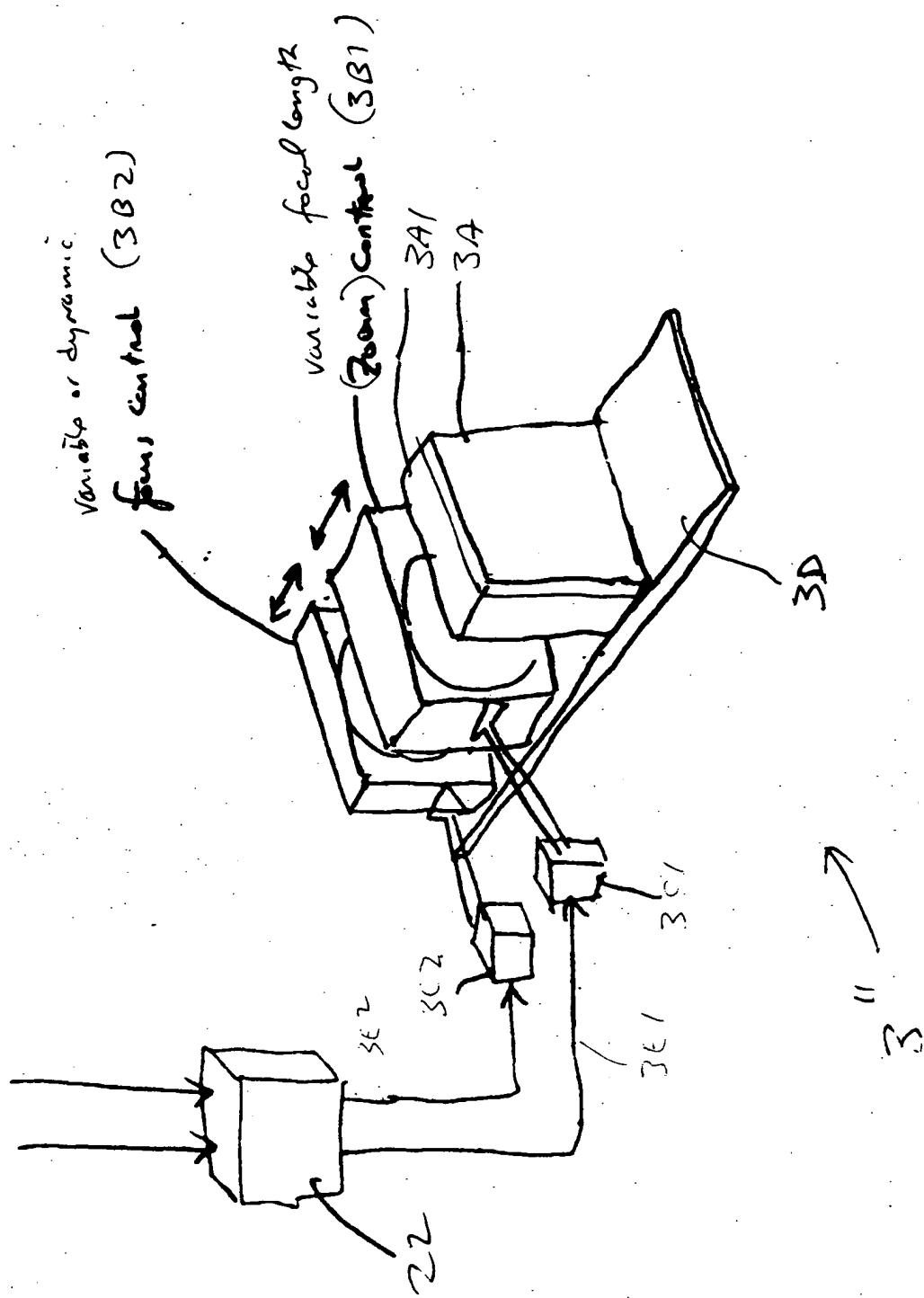
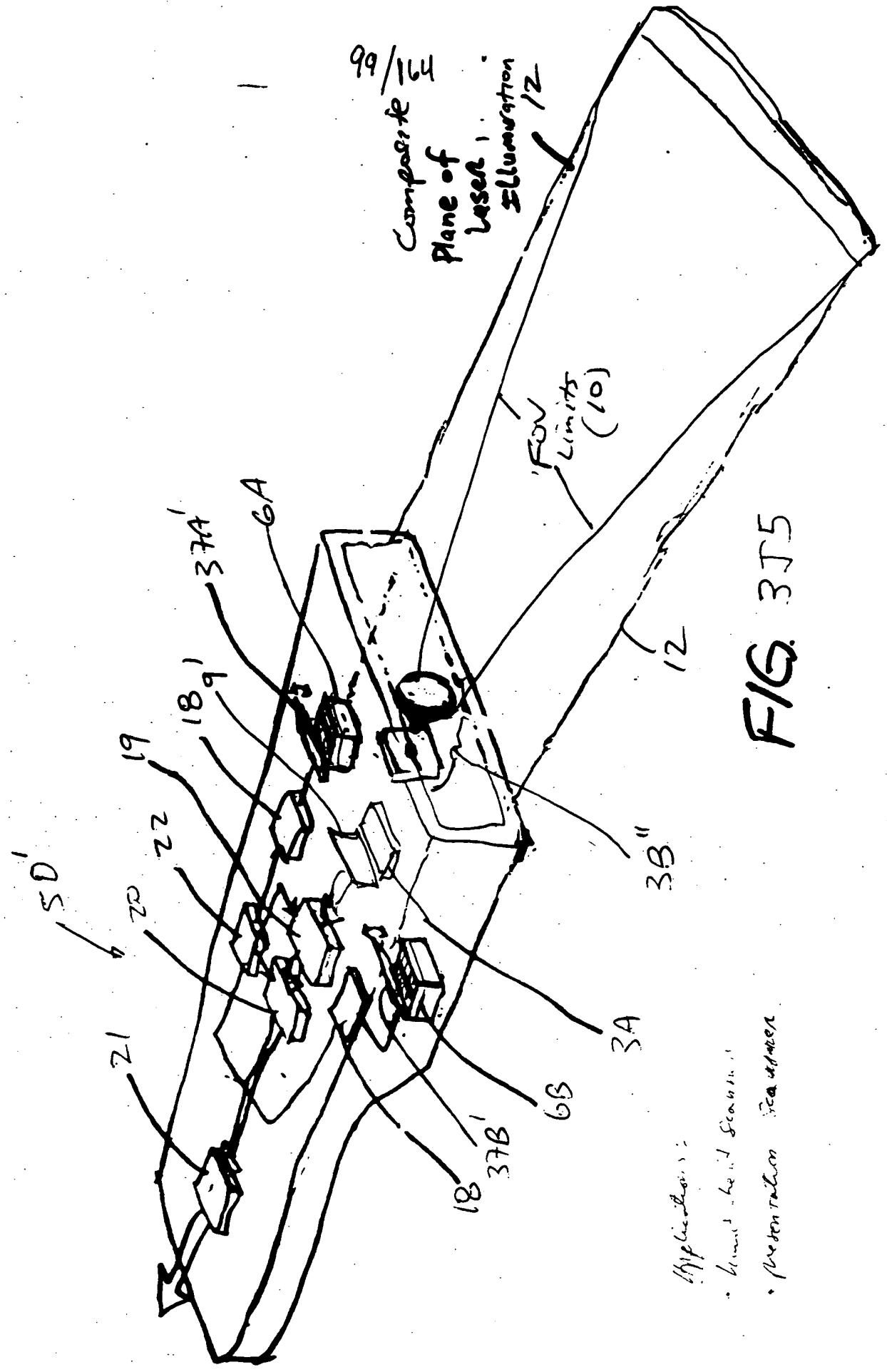


Fig. 354

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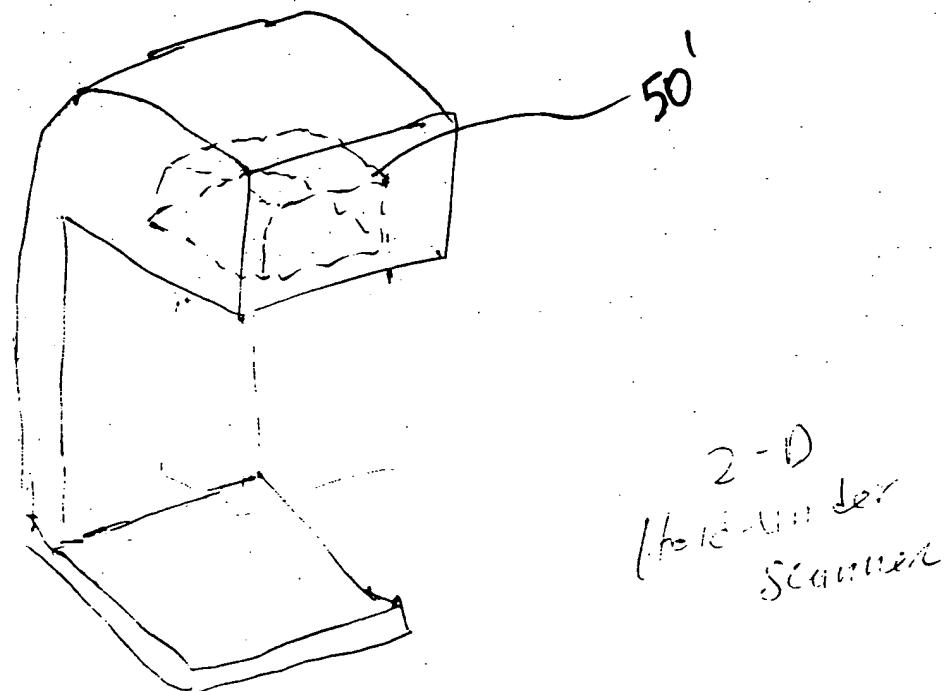
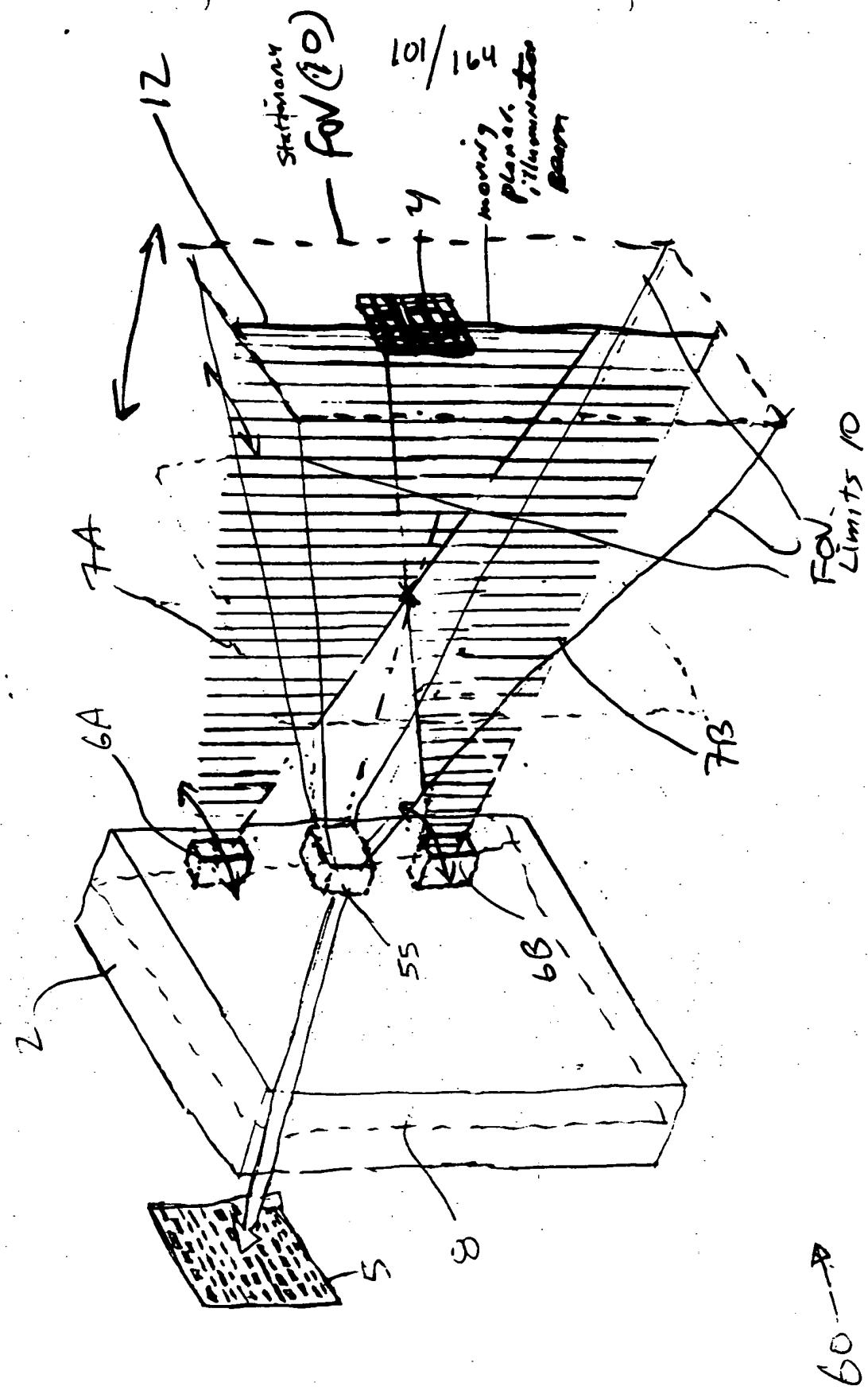


FIG. 316



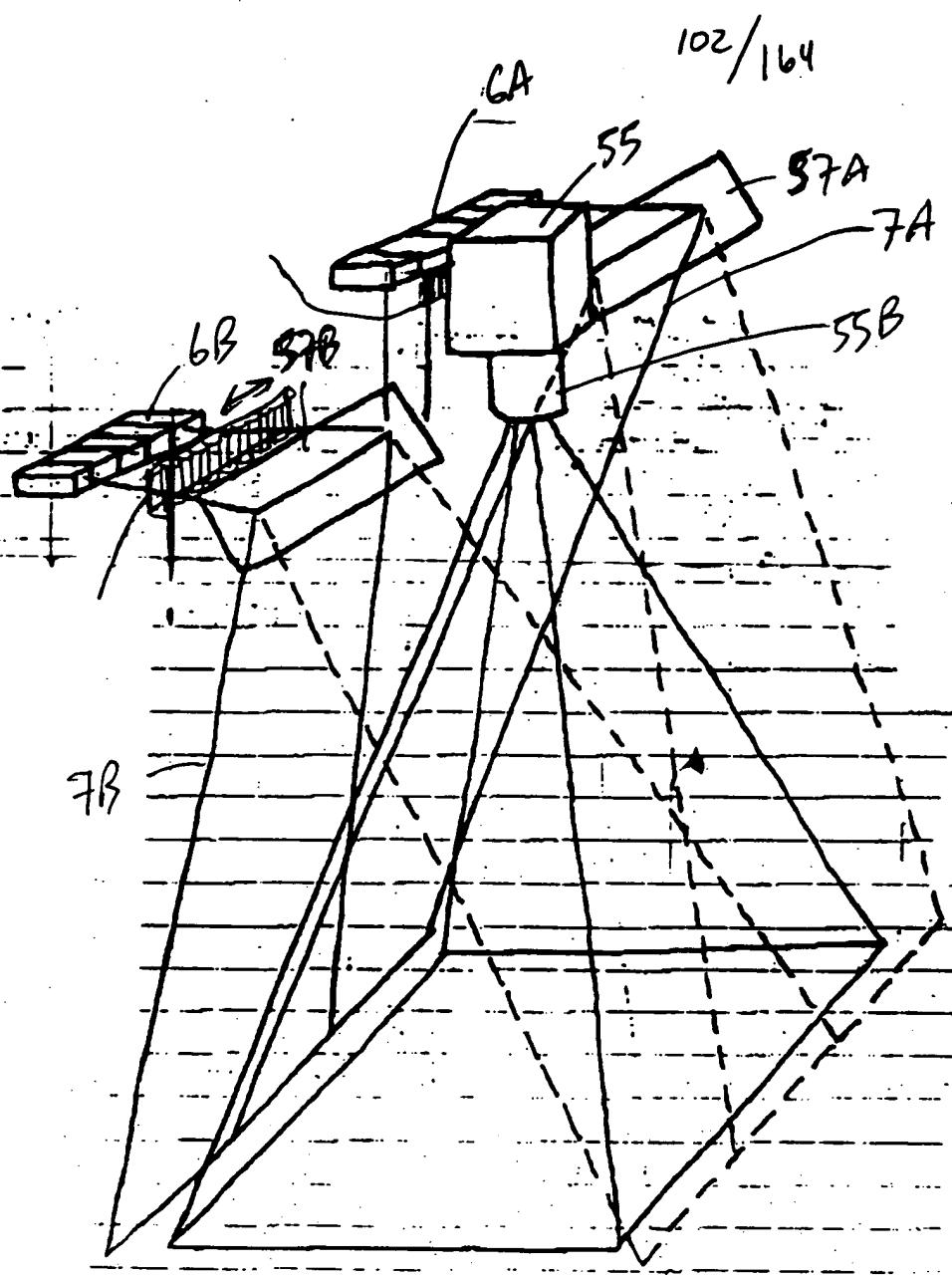
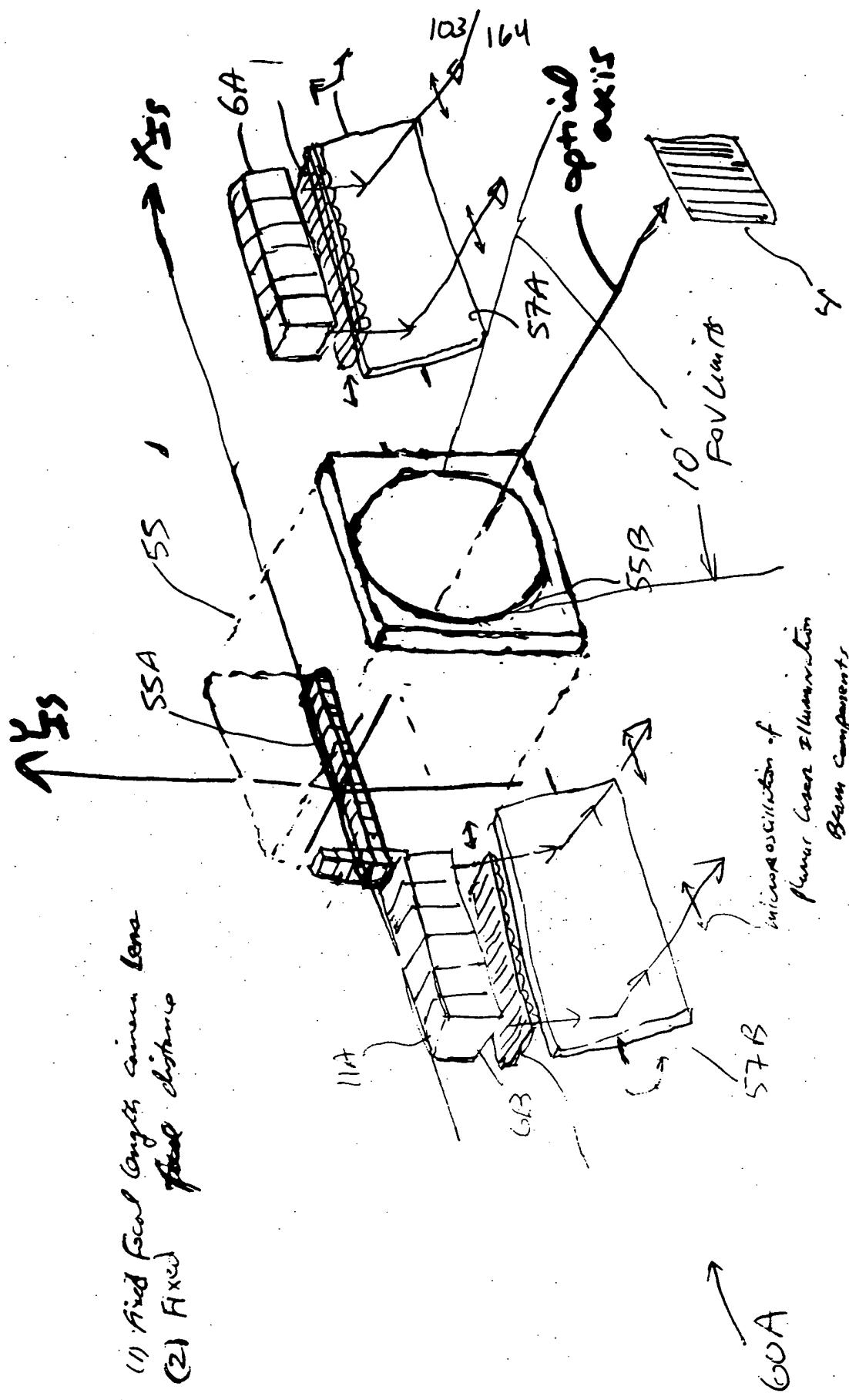


FIG. 4B1



(1) Fixed focal length camera lens
 (2) Fixed ~~focal~~ distance

Planar Green Elastomer Beam Components

FIG. 4B2

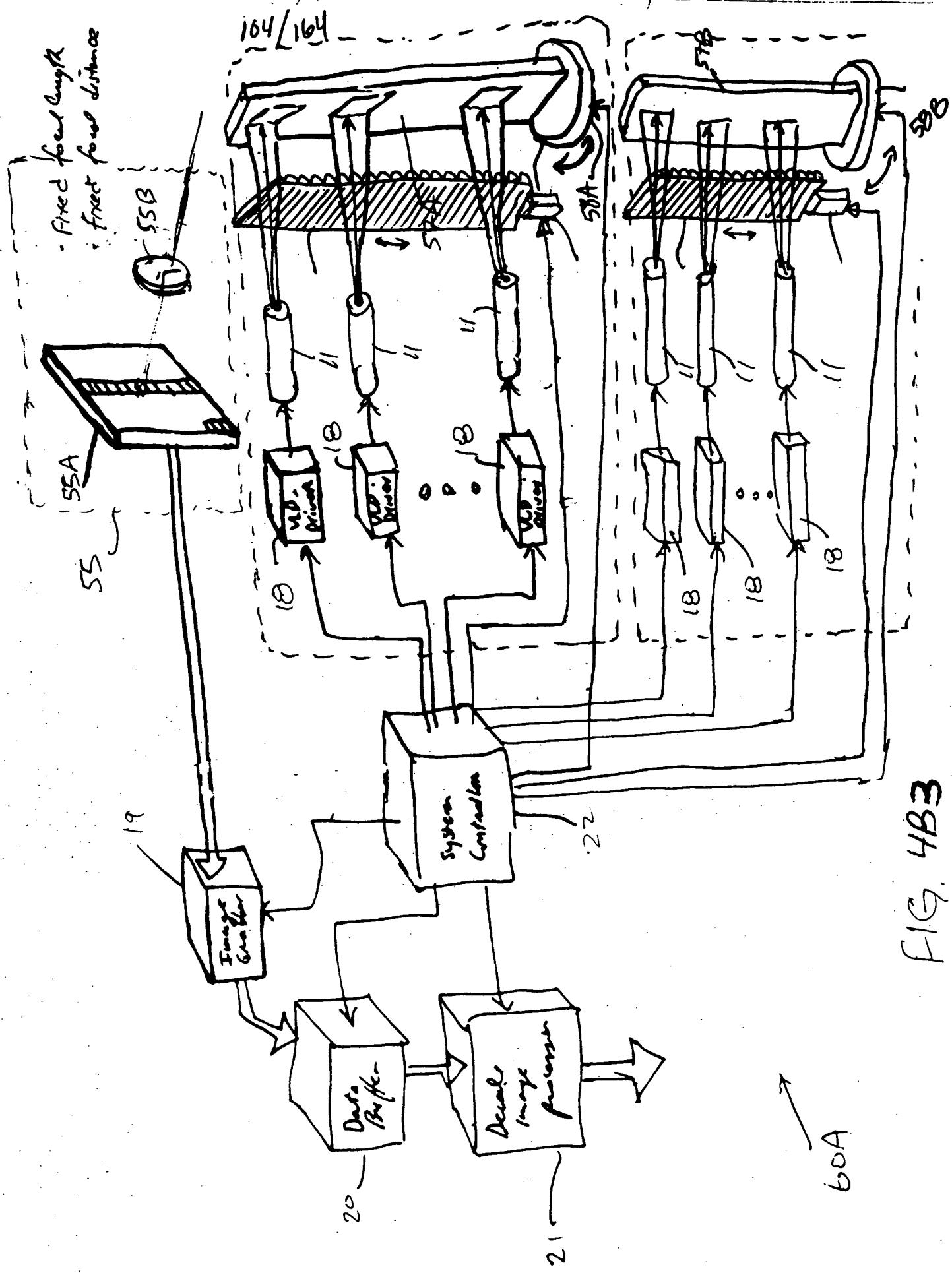


FIG. 4B3

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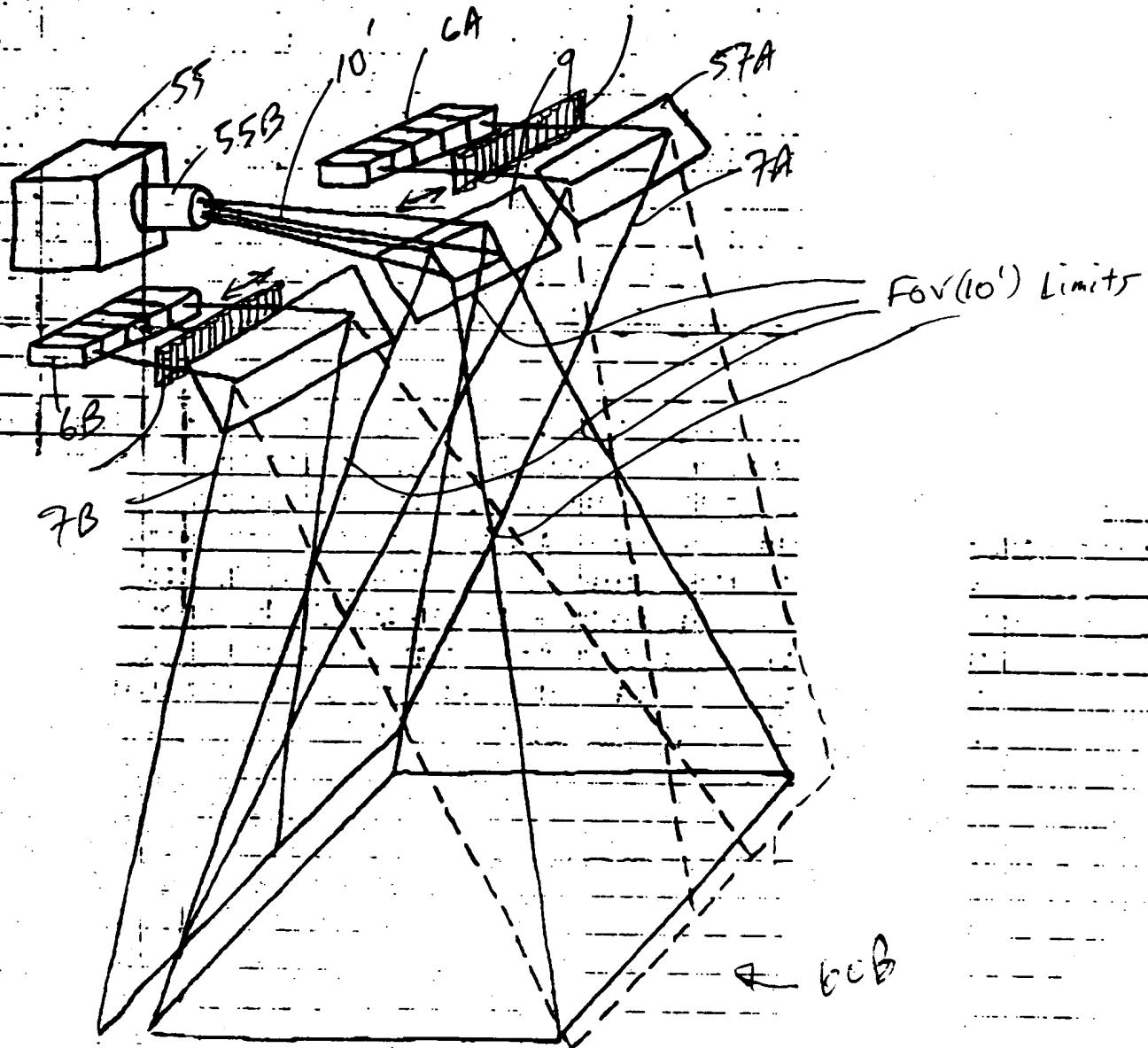
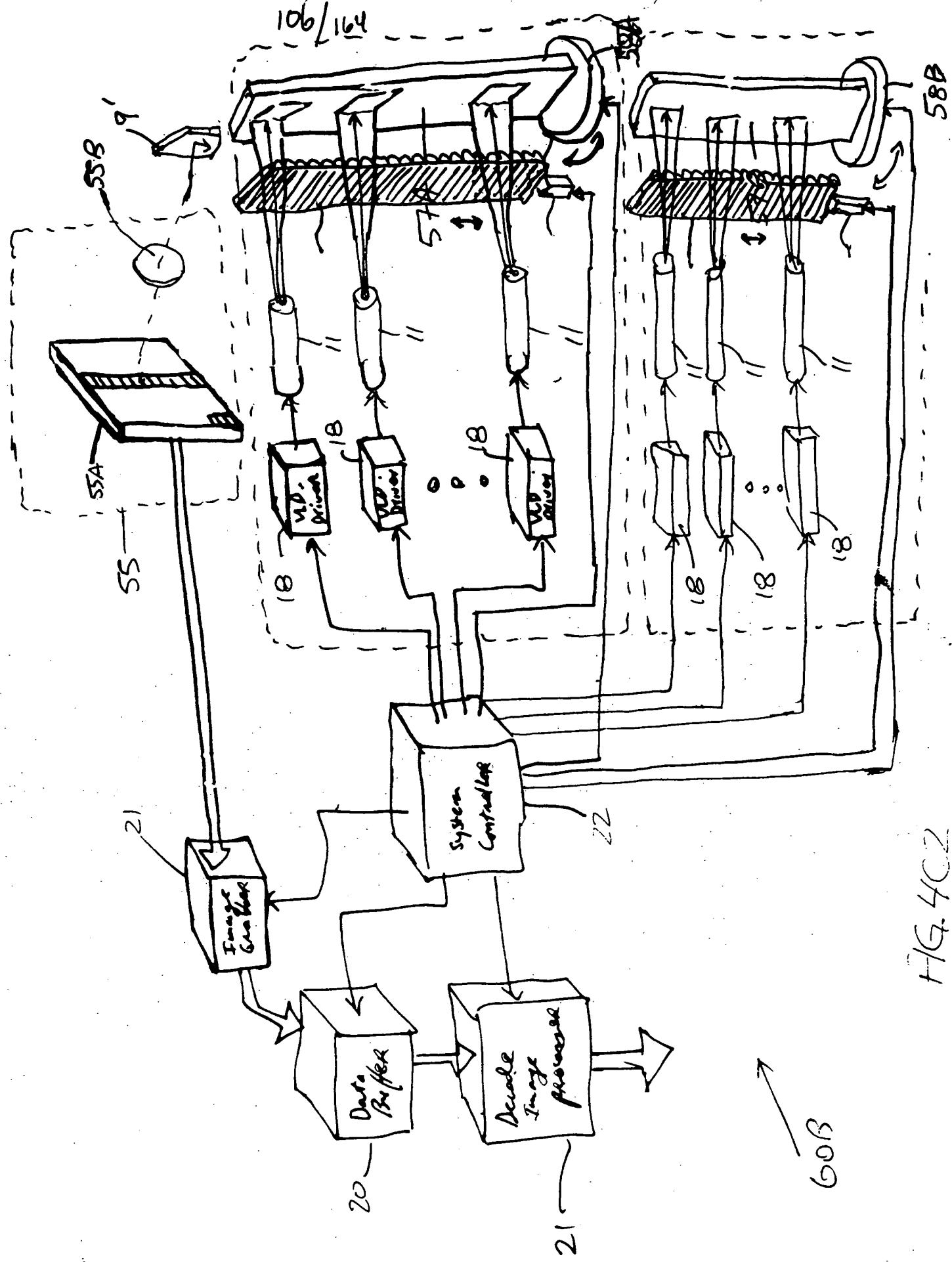


FIG. 4C1



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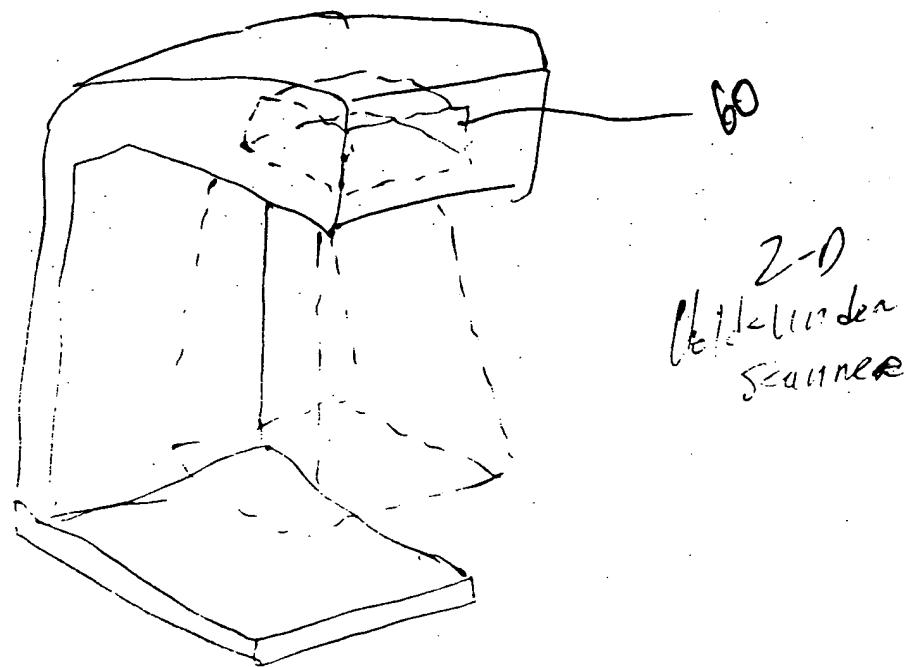


FIG. 4D

Or

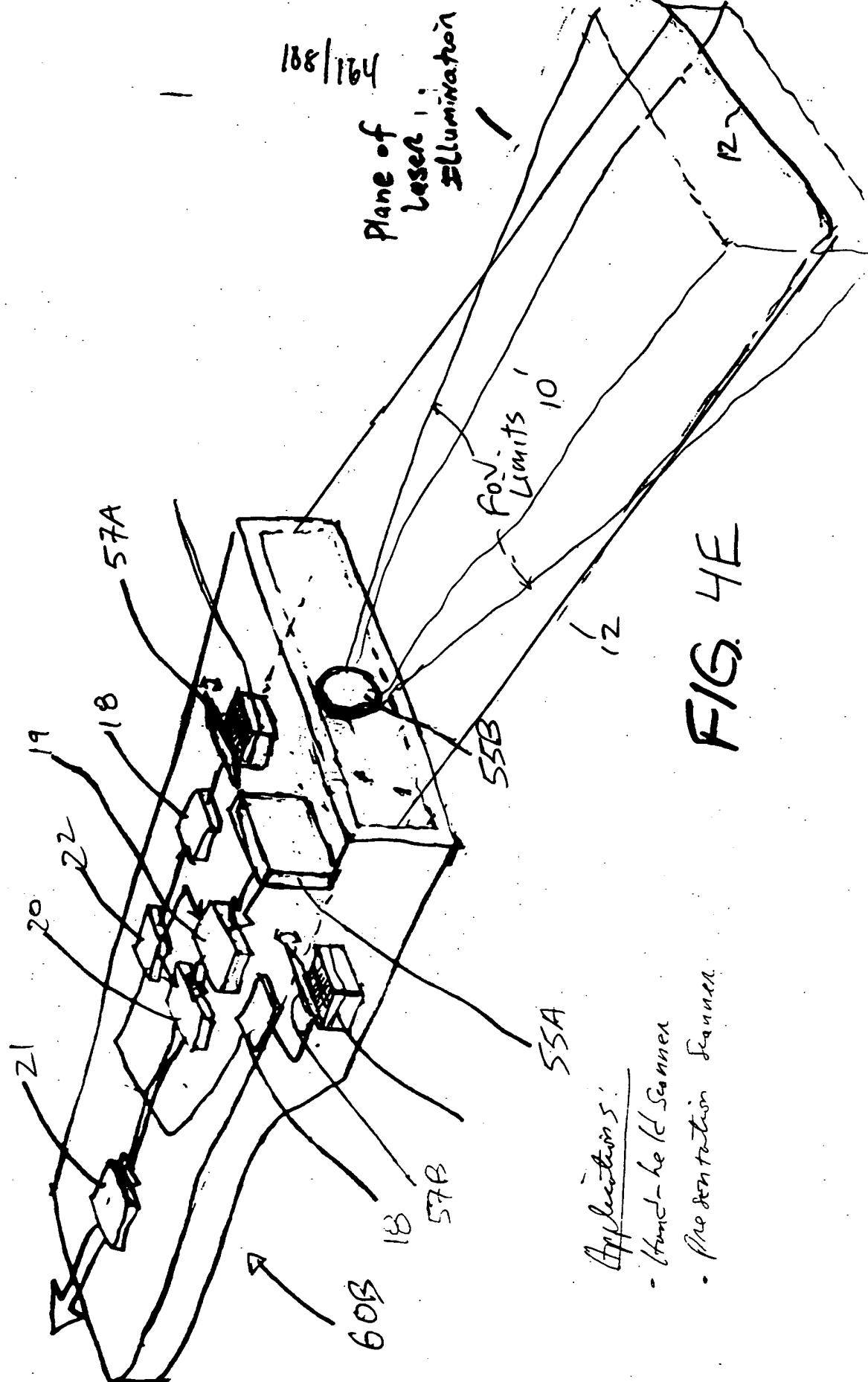
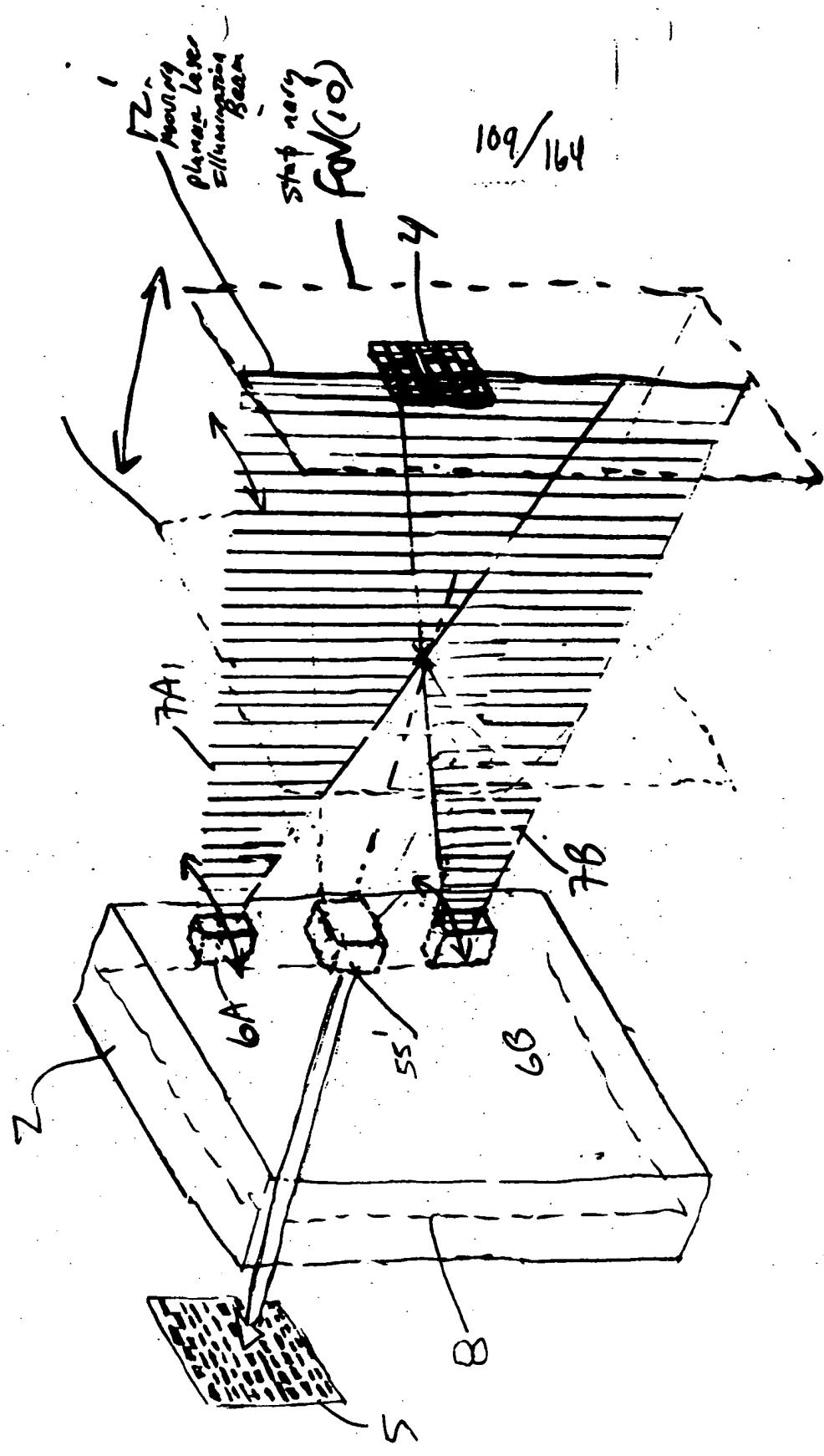


FIG. 4E



AG. 5A

70 →

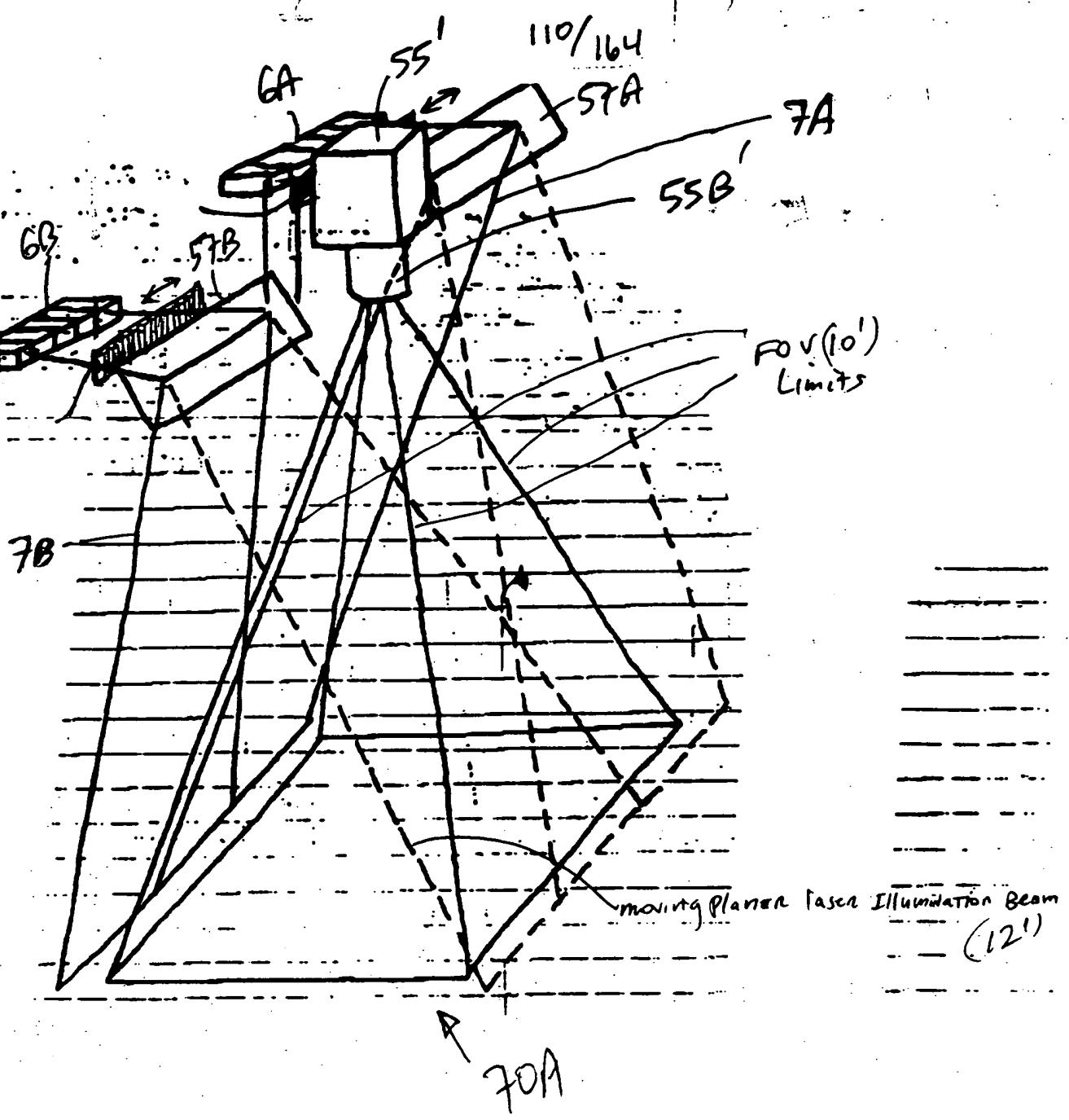


FIG 5B1

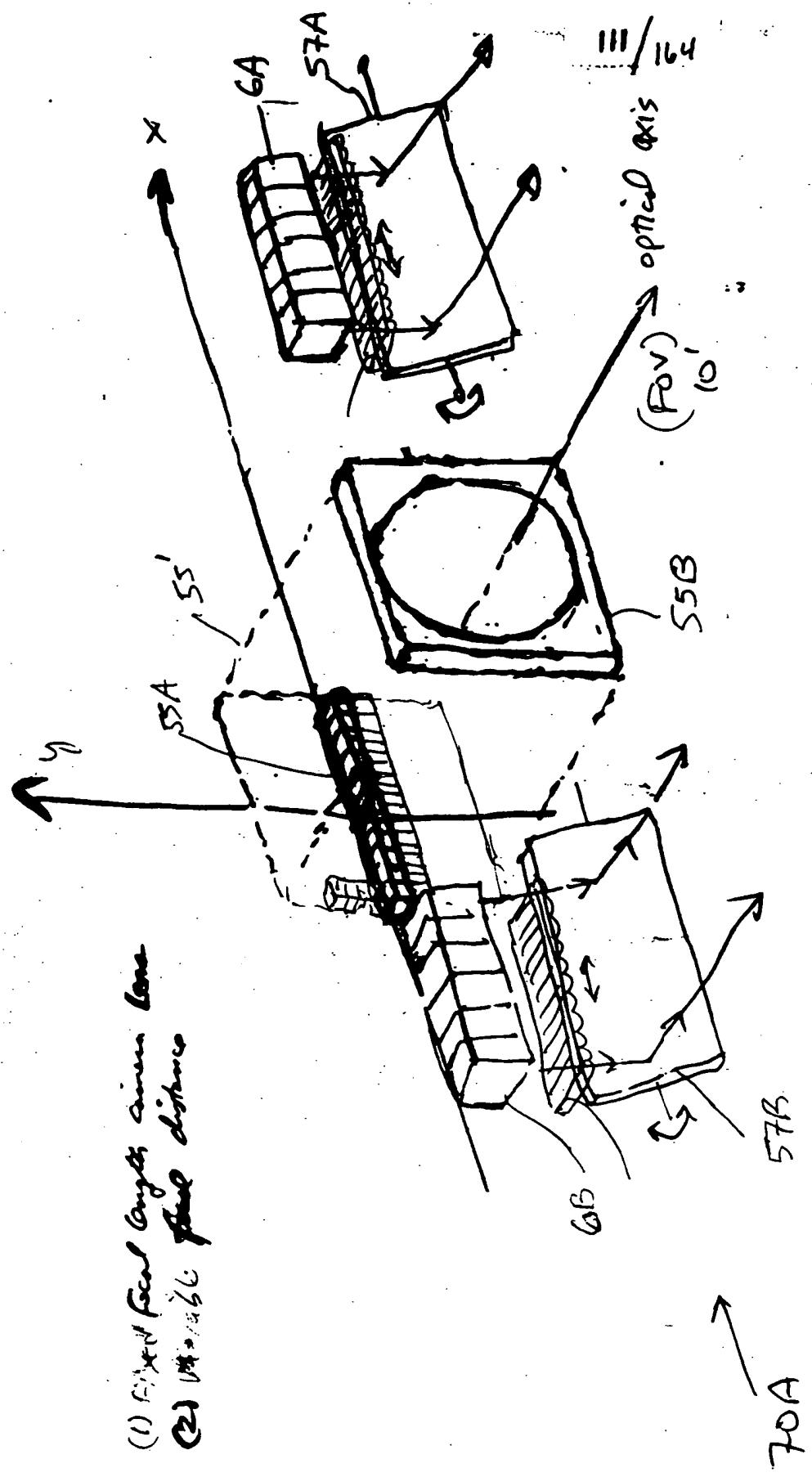
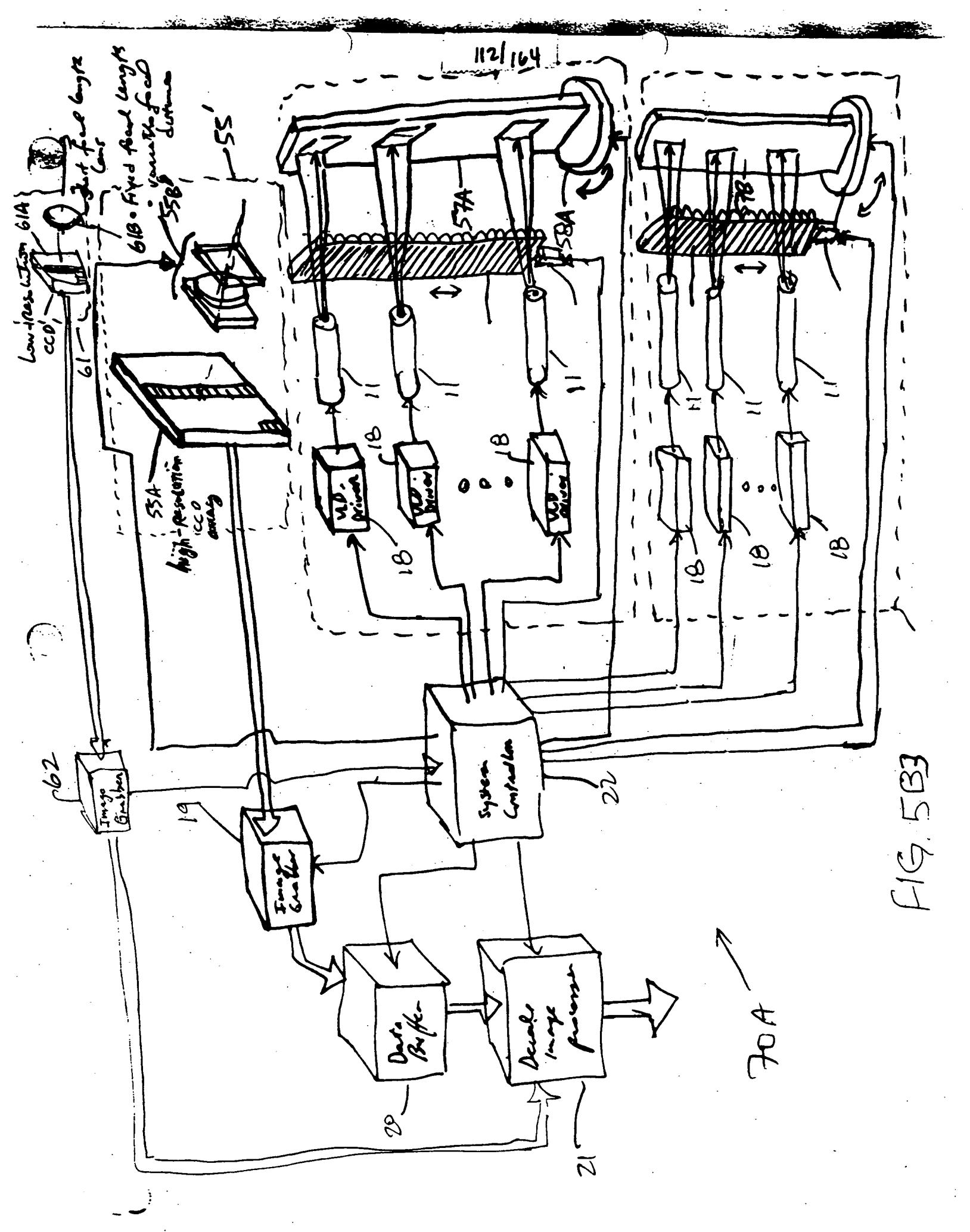


FIG: 5B2



F1G1 5B3

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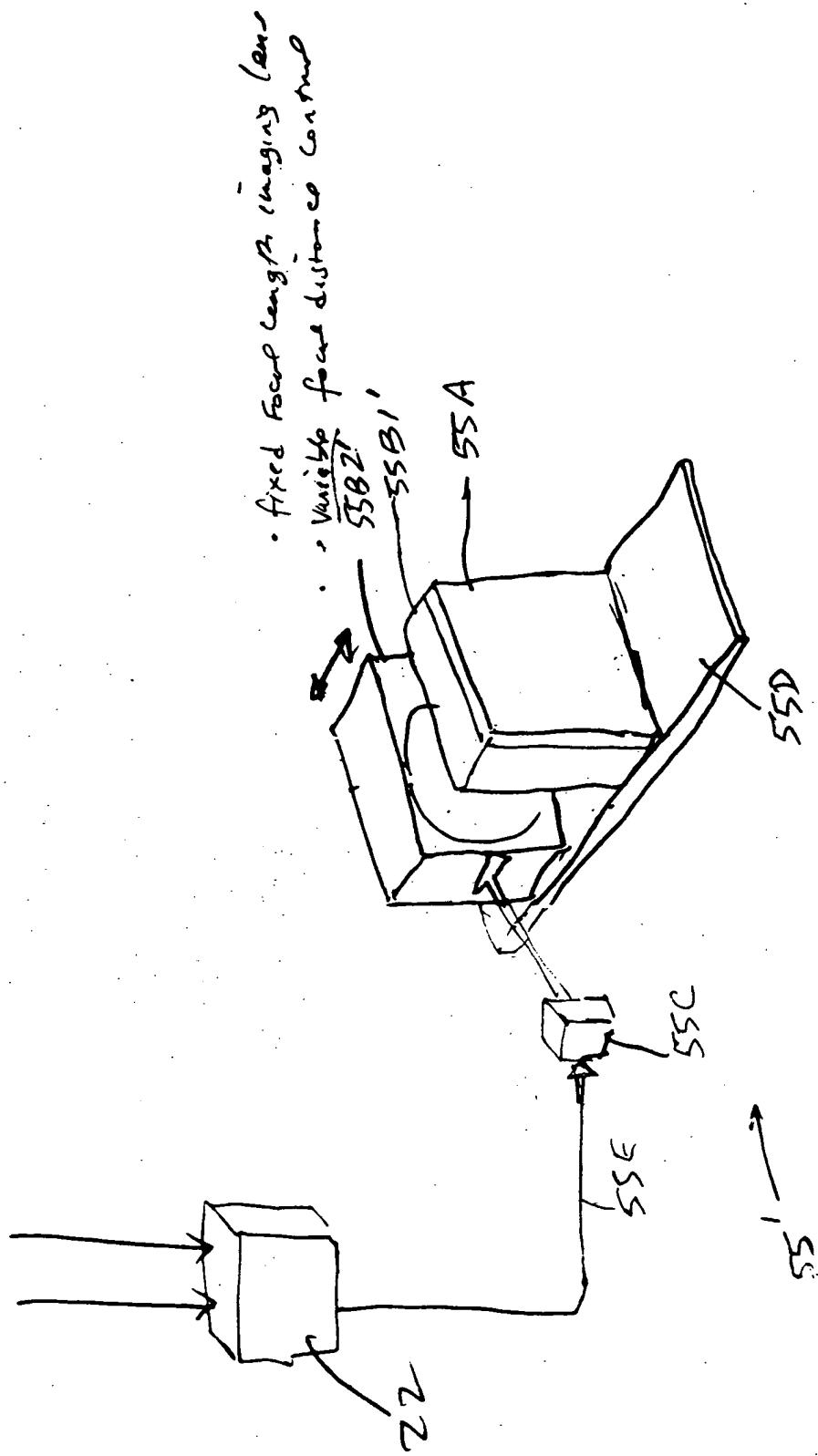


FIG. 584

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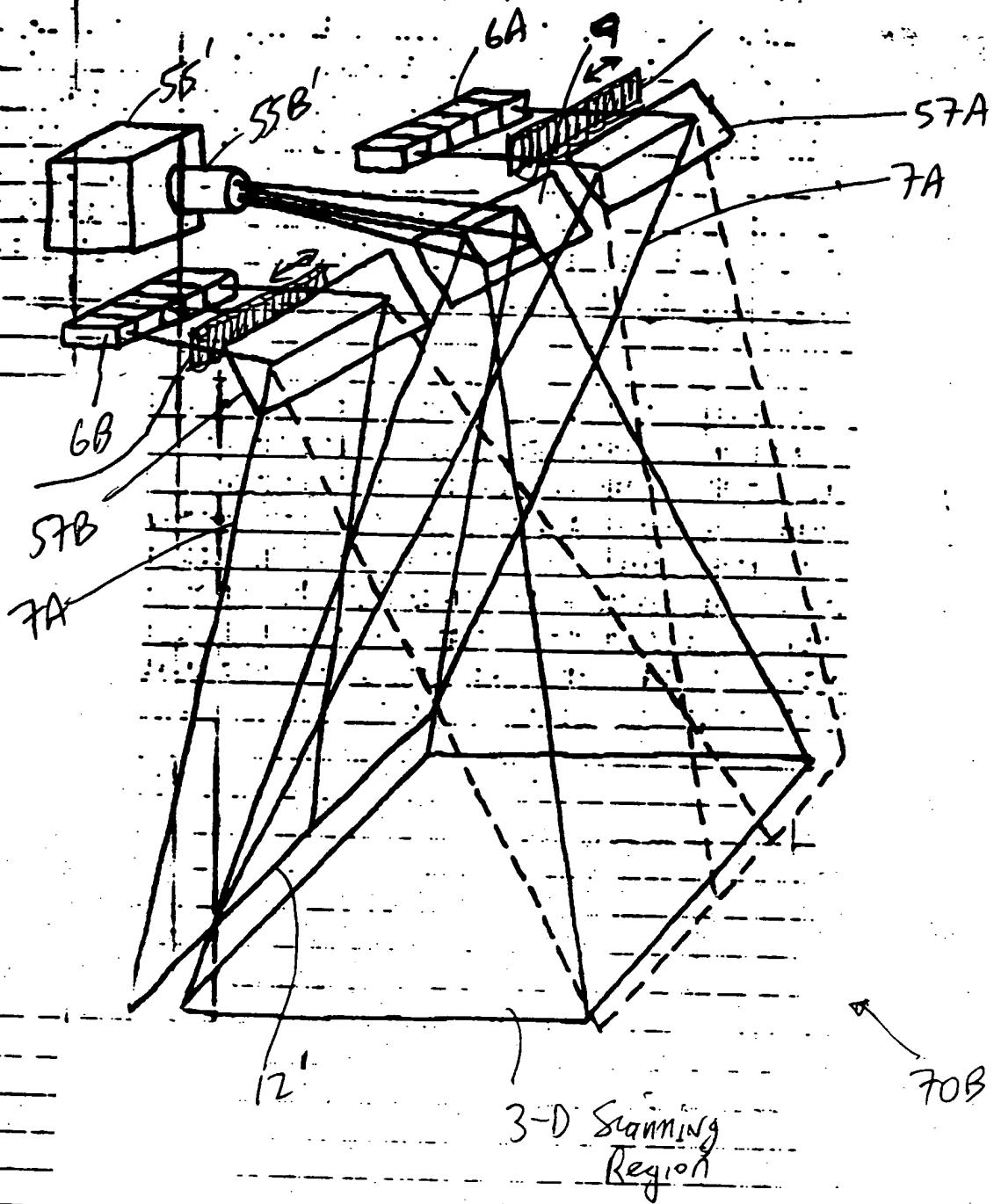
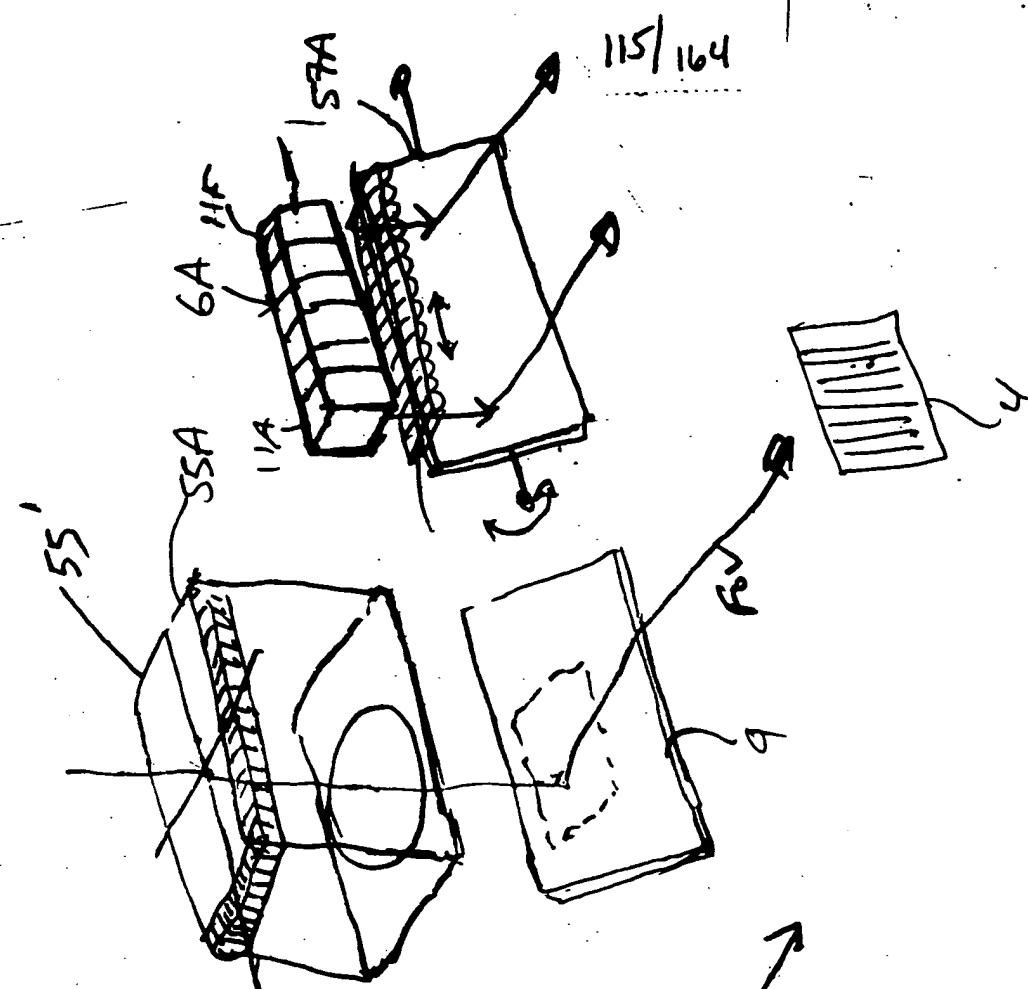


FIG. 5C1



(1) Variable focal length camera lens
 (2) Fixed ~~fixed~~ ~~fixed~~ distance

70G → 57B

FIG. 5C2

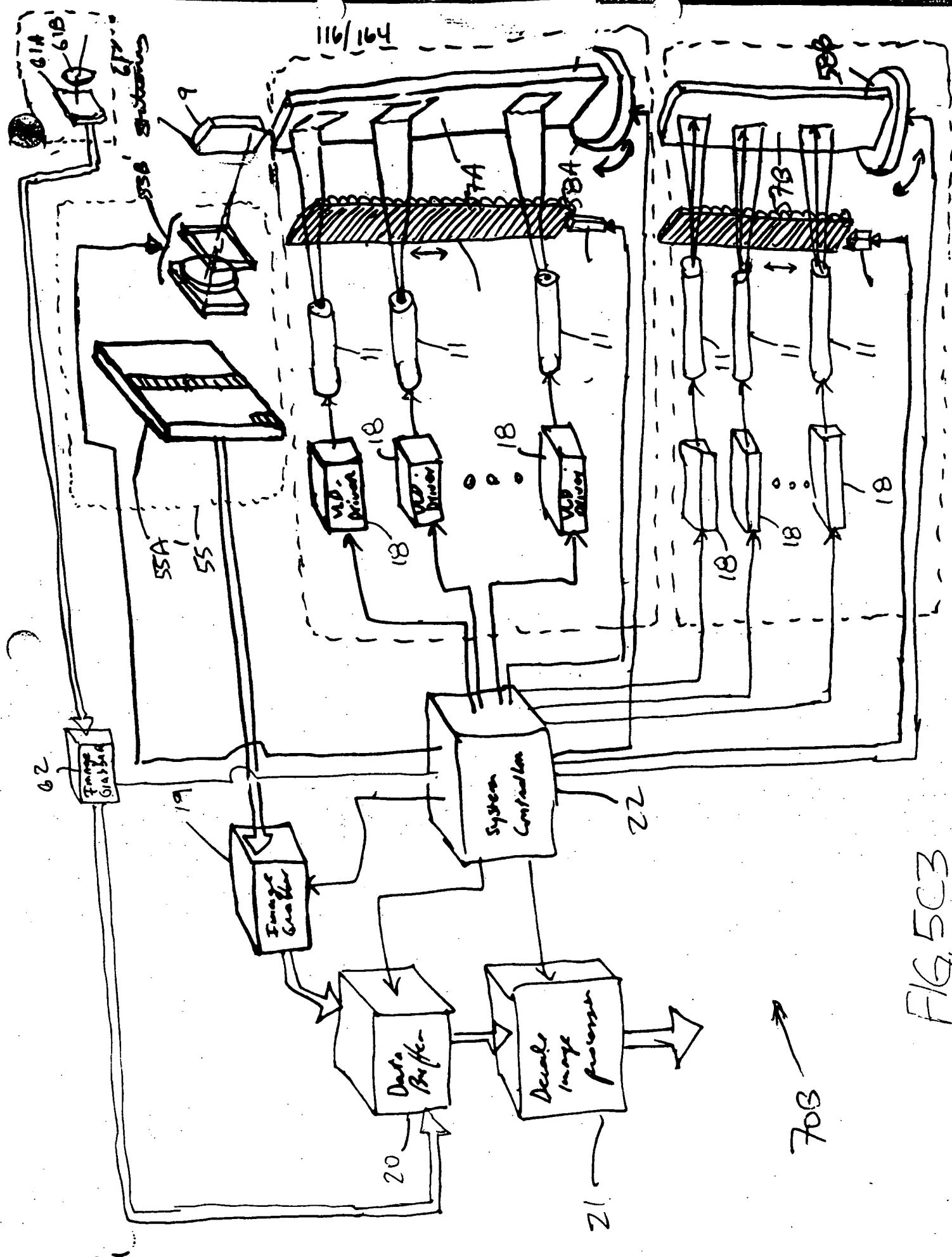


FIG. 5C3

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fixed food sought, ranging over
variable food distance control

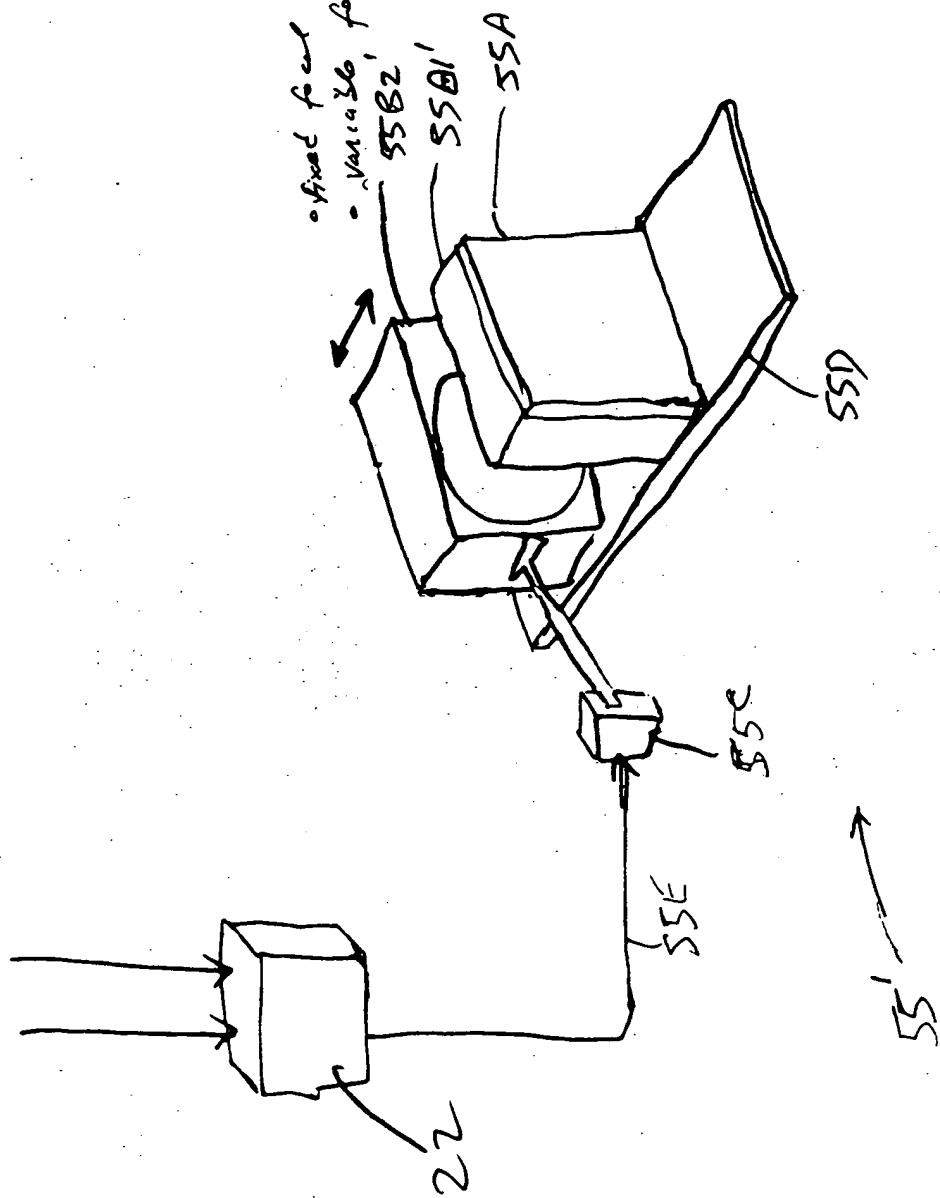


Fig. 5c4

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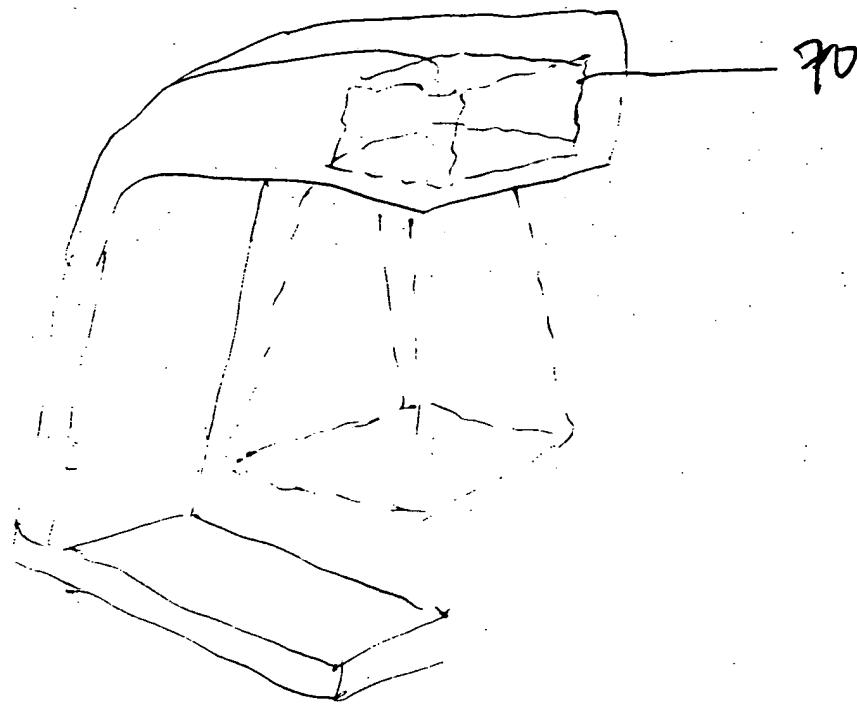


FIG. 5D

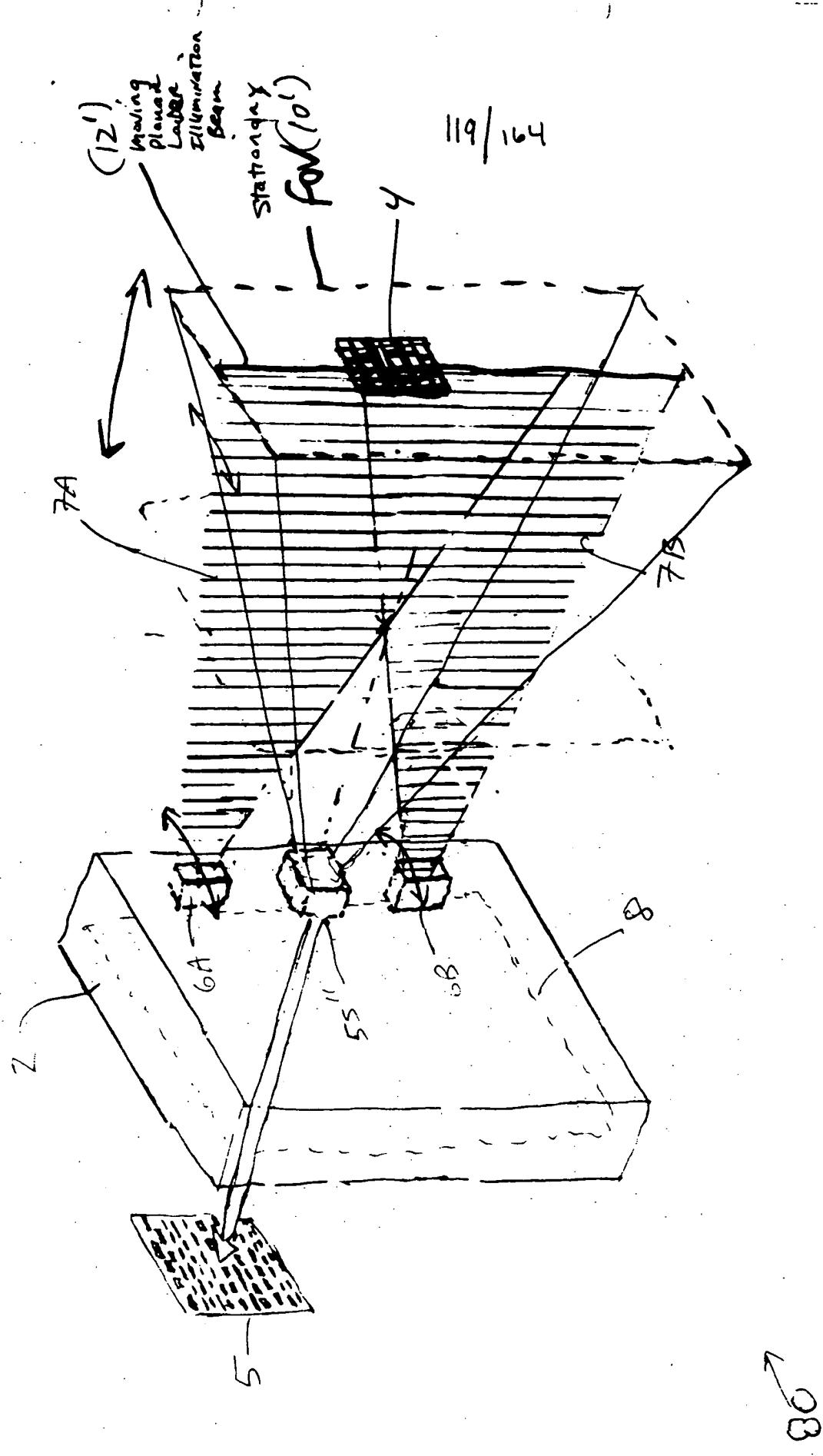


Fig. 6A

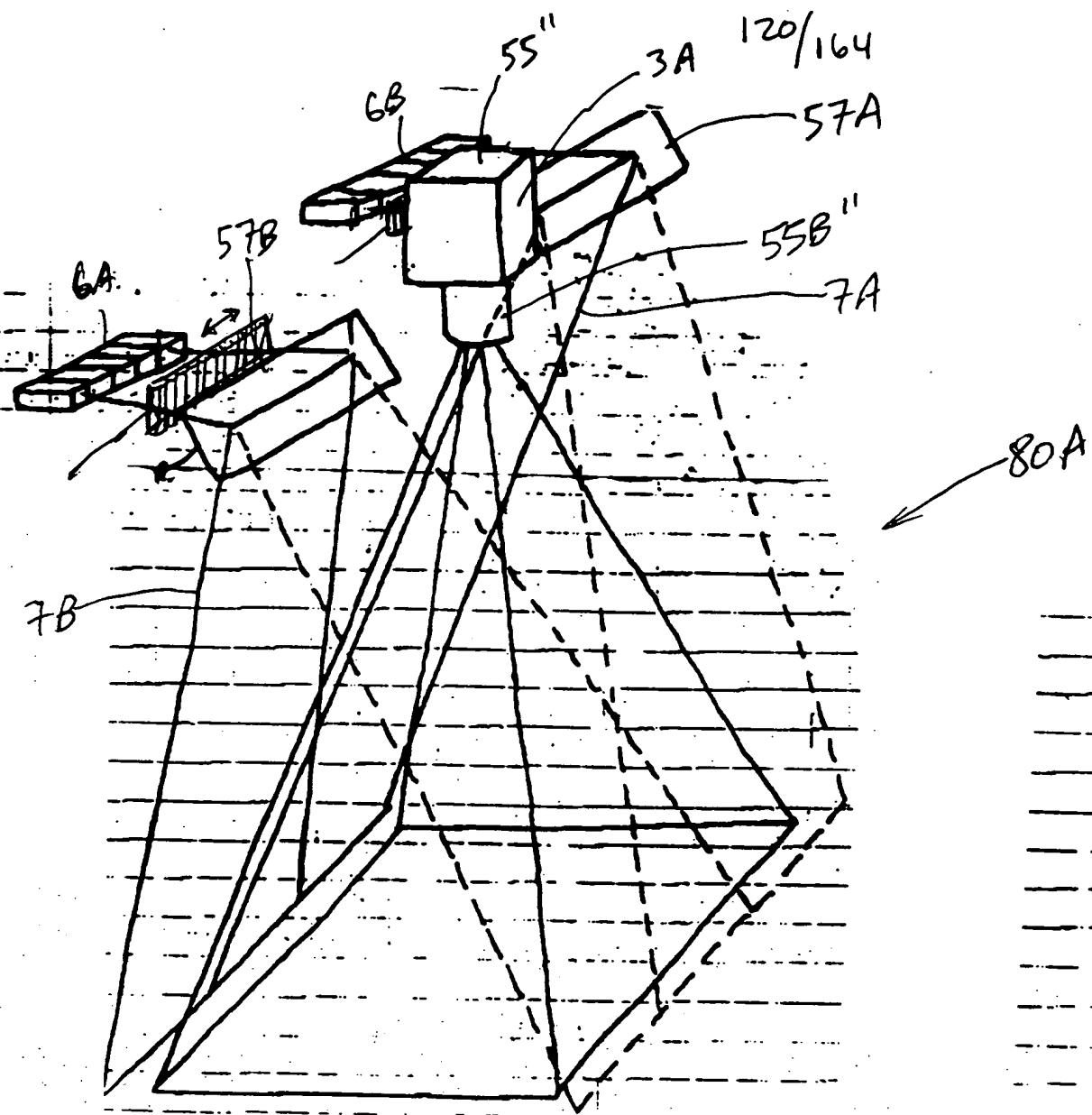


FIG. 6B1

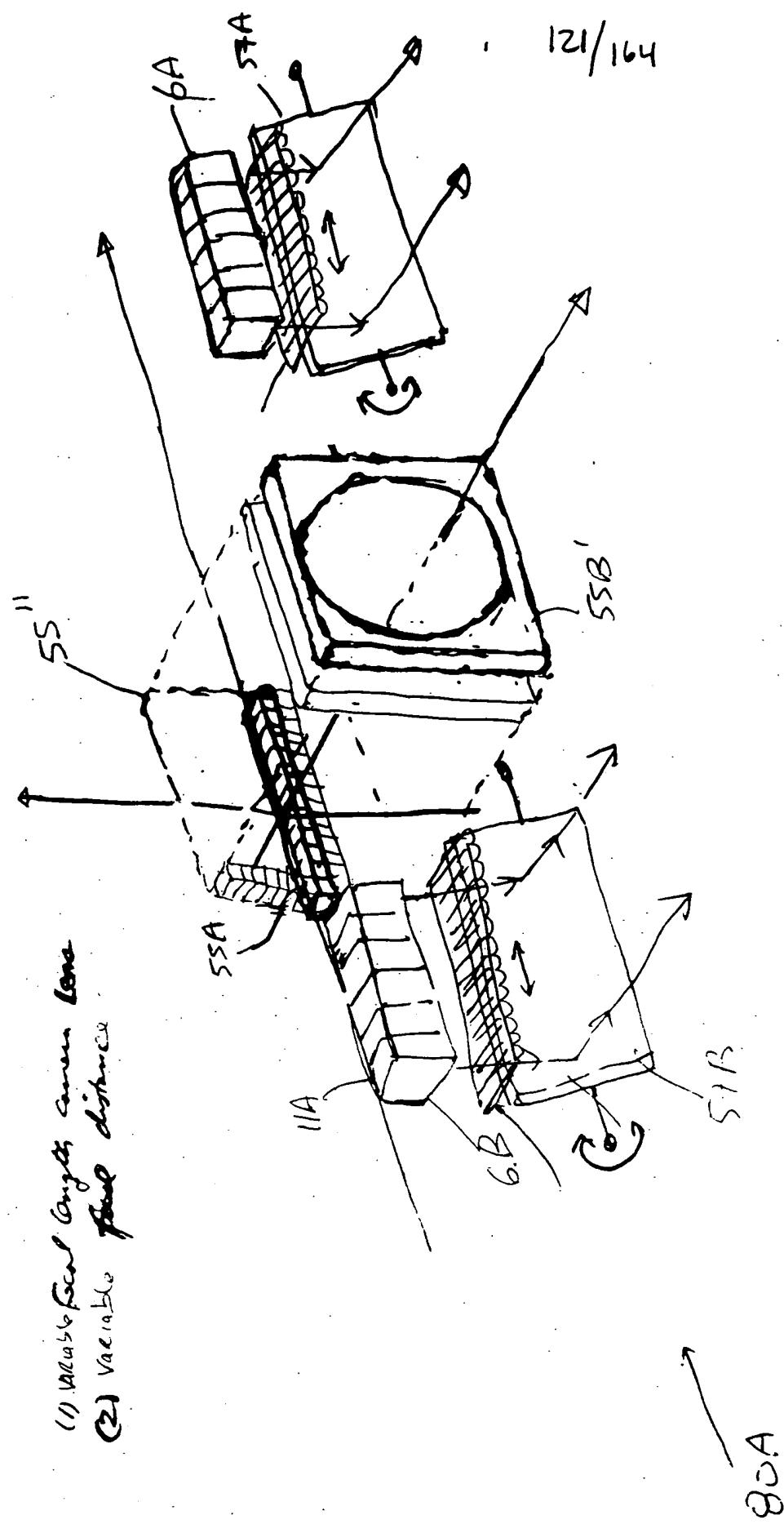


FIG: 6B2

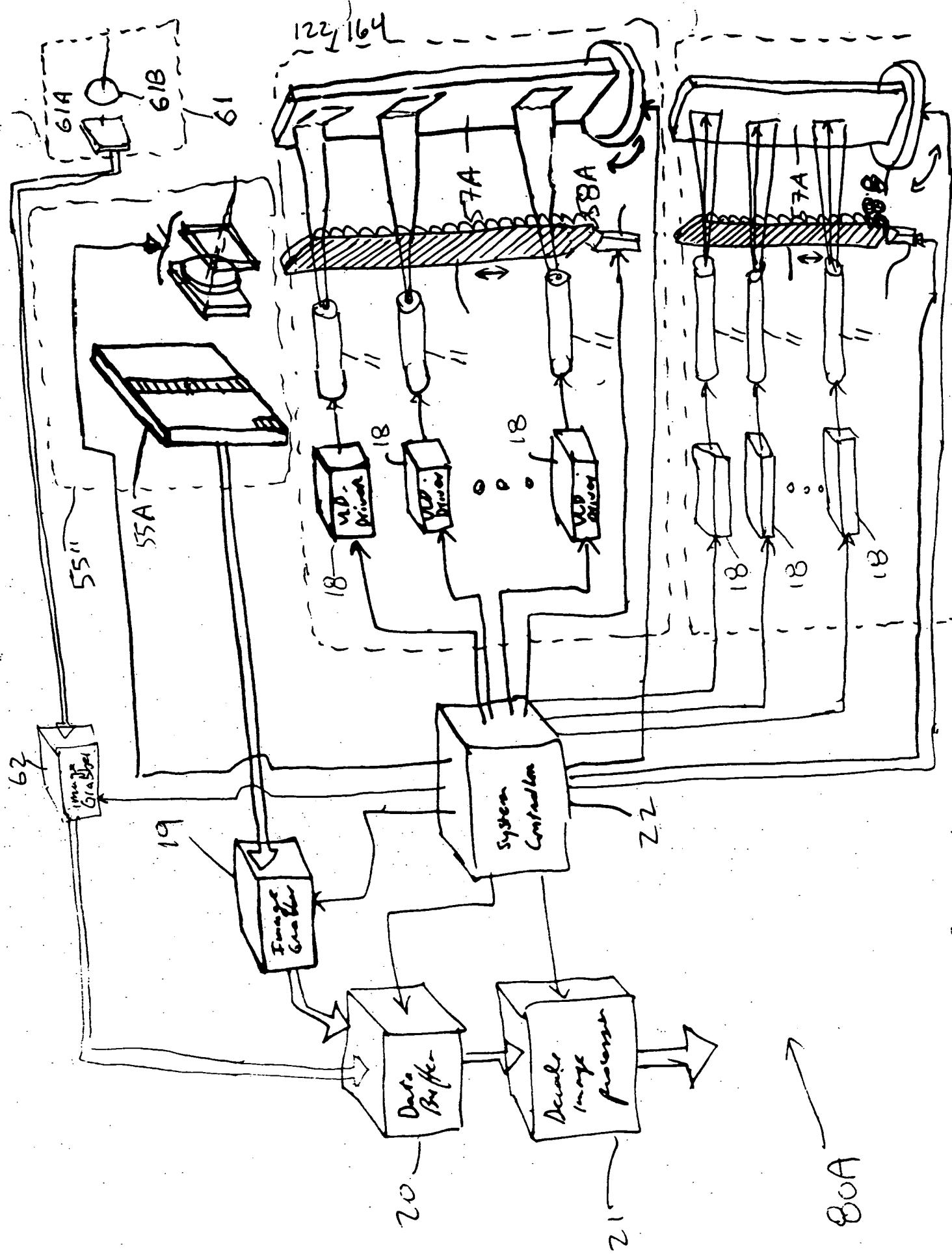


FIG. 6B3

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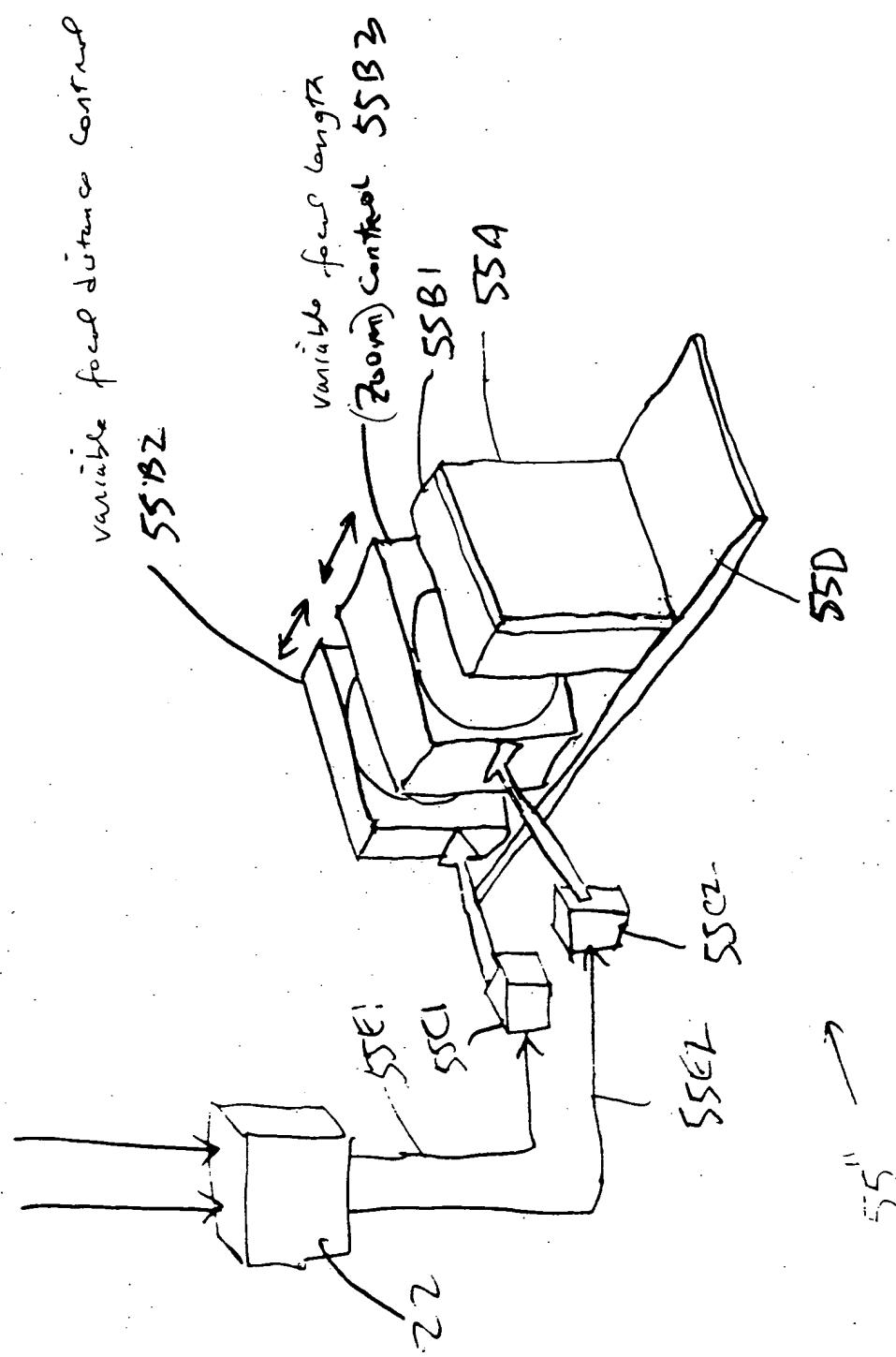


FIG. 6B4

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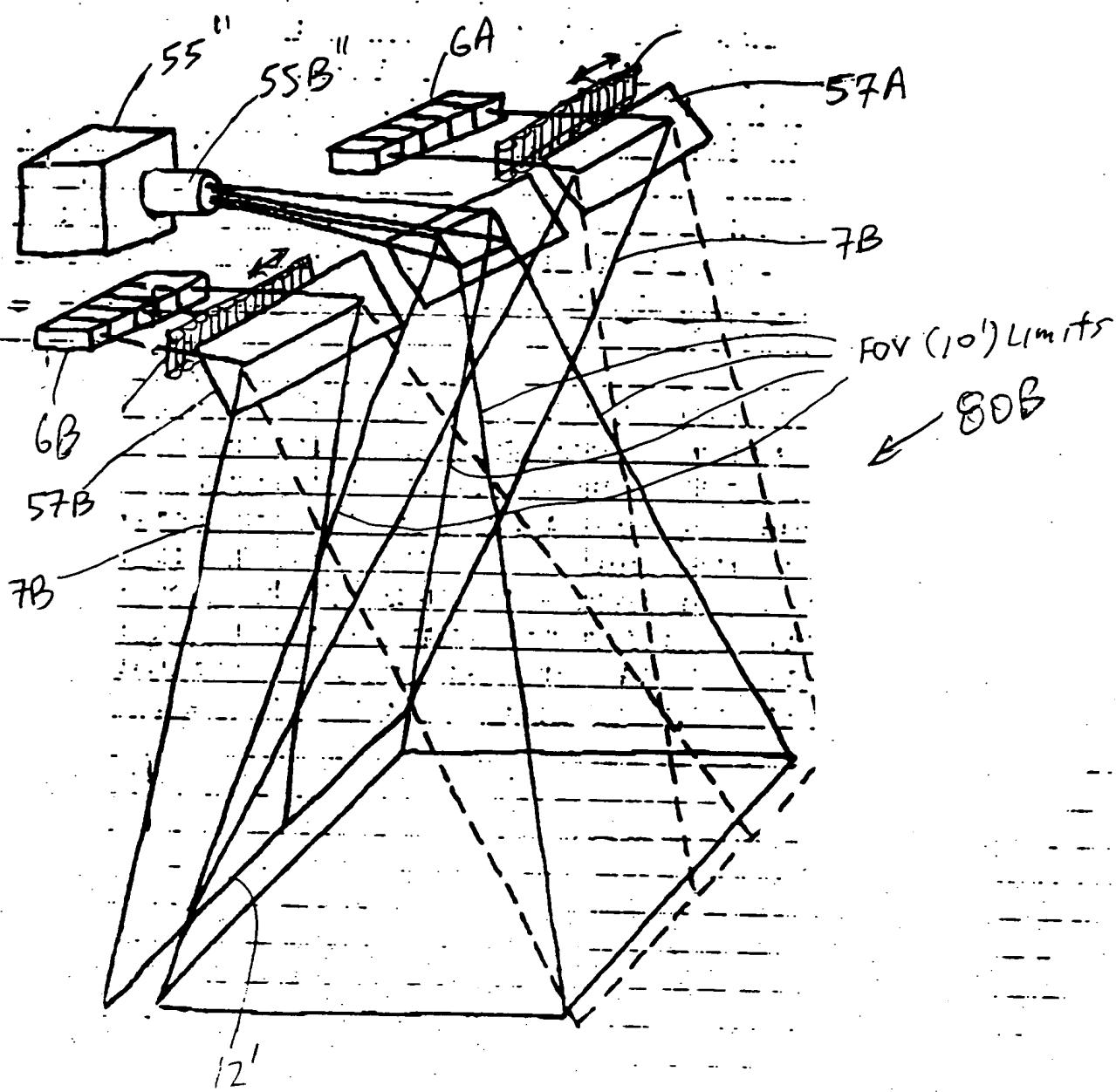
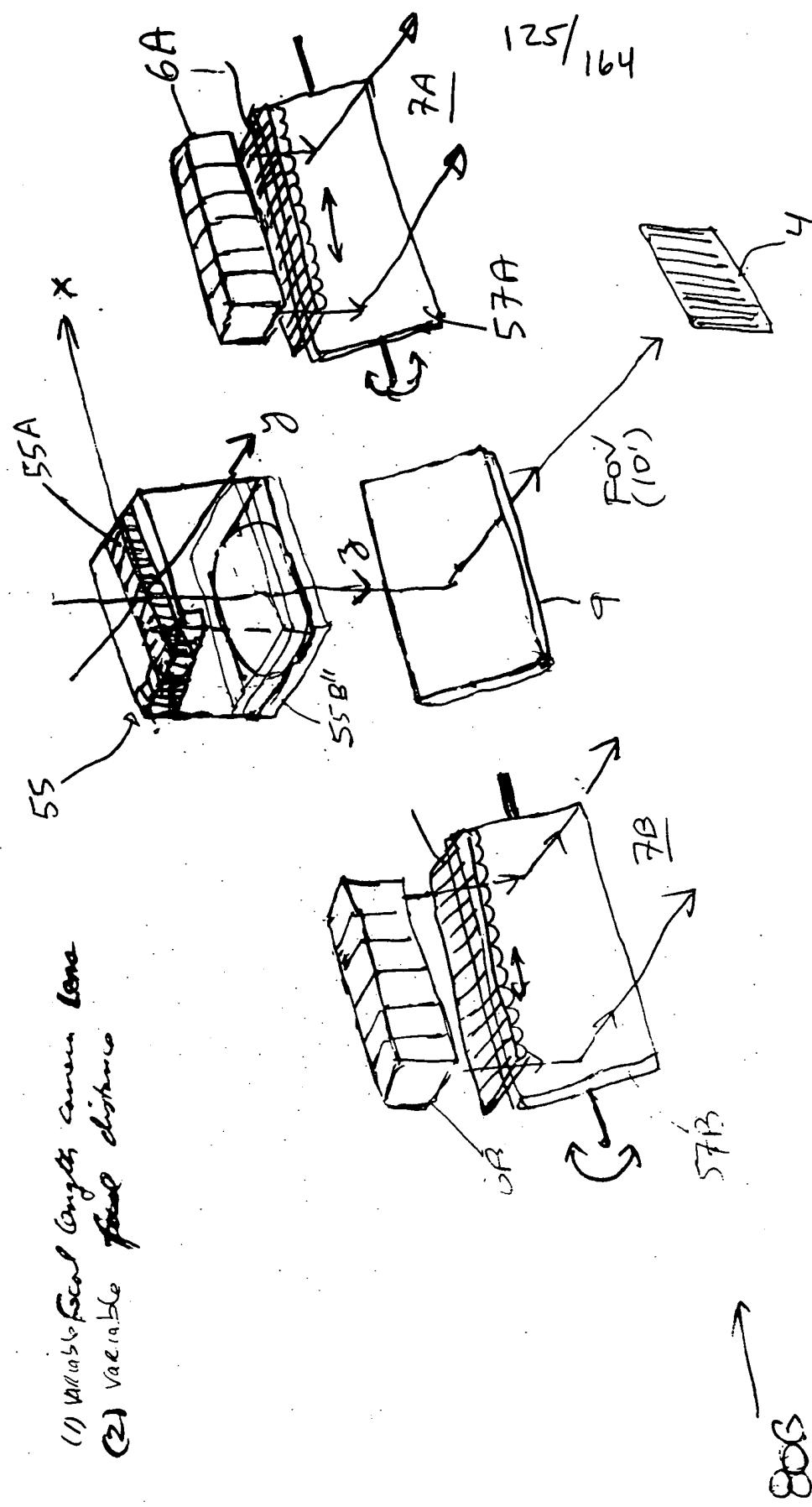


FIG. 6C1



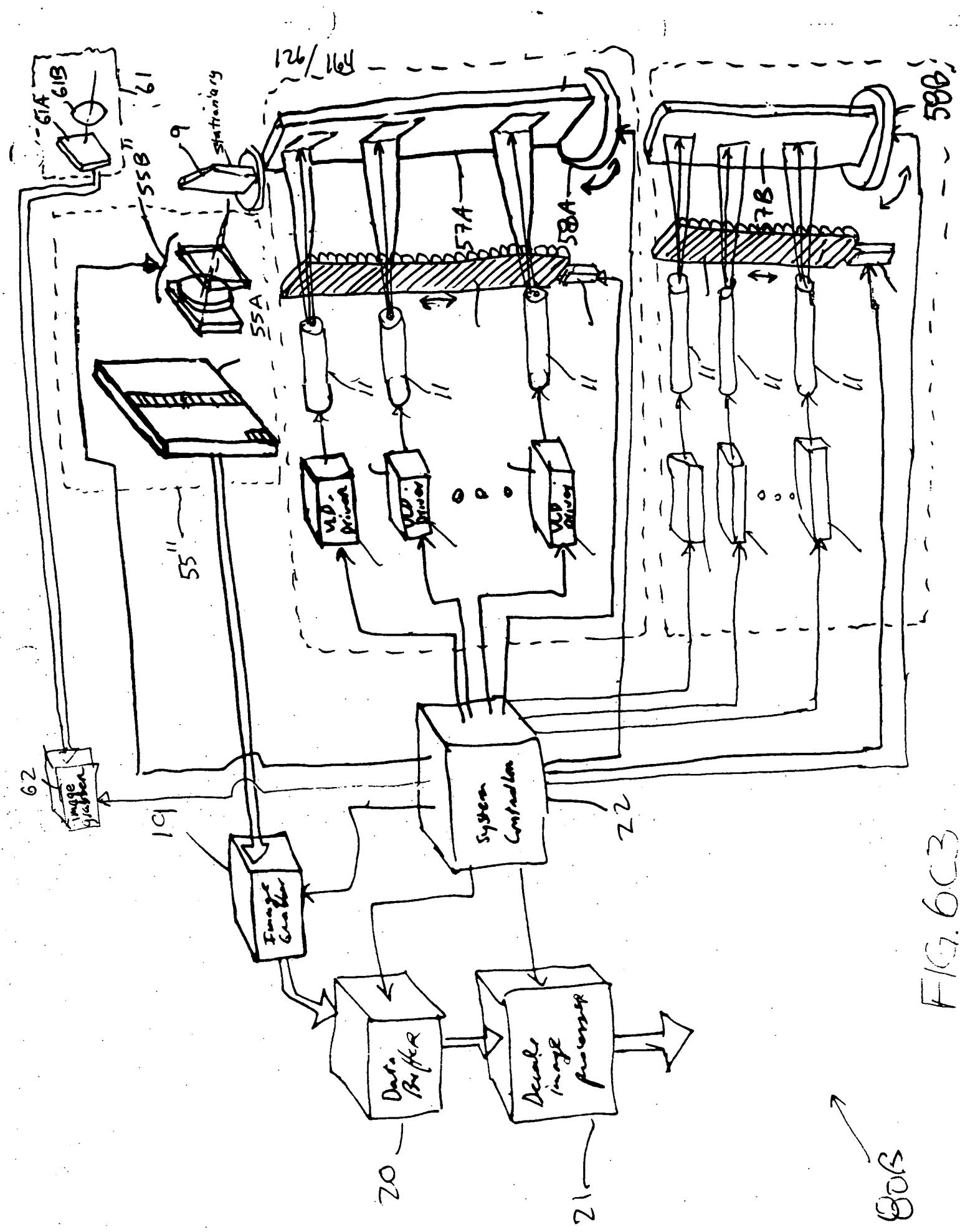


FIG. 6C3

GOPS

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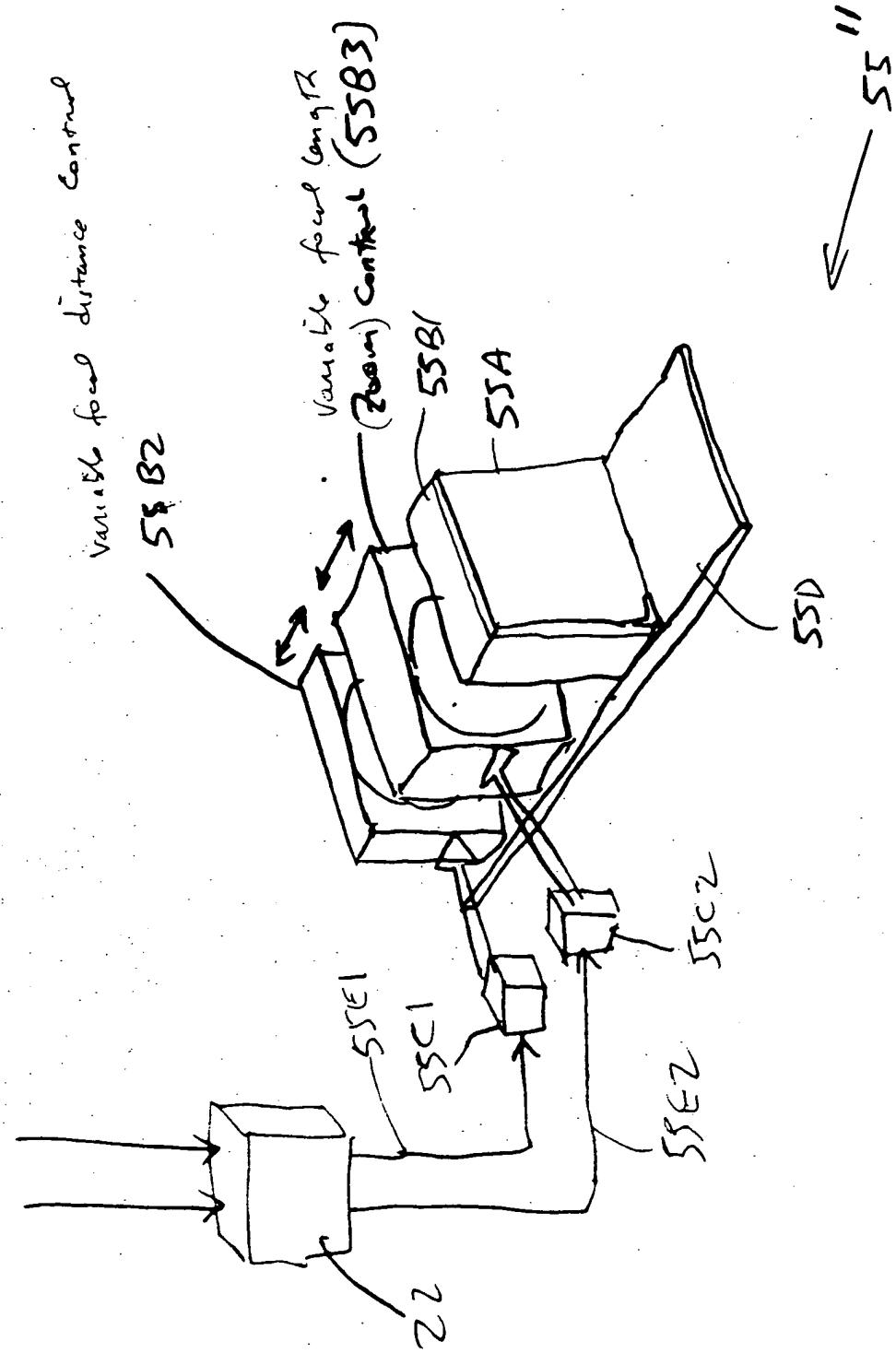


FIG. B.C4

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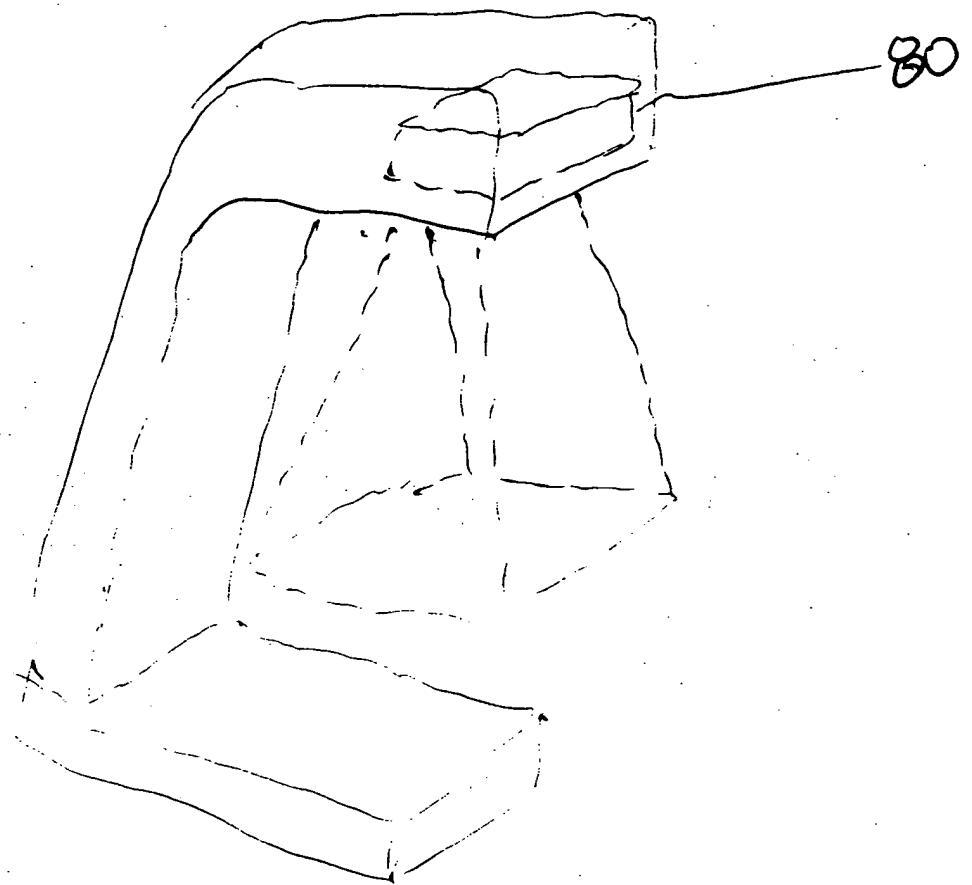


FIG. 6D

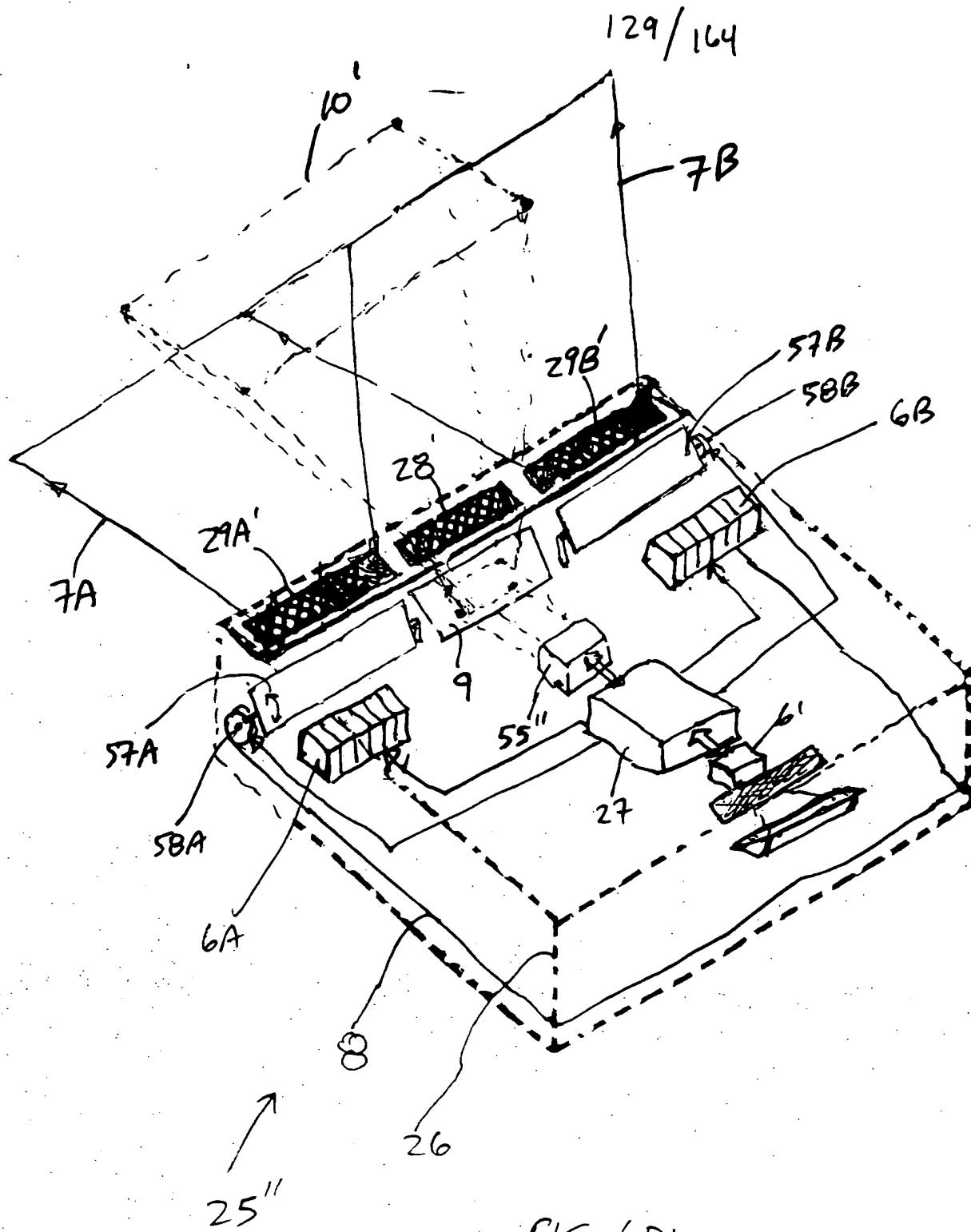


FIG. 6D1

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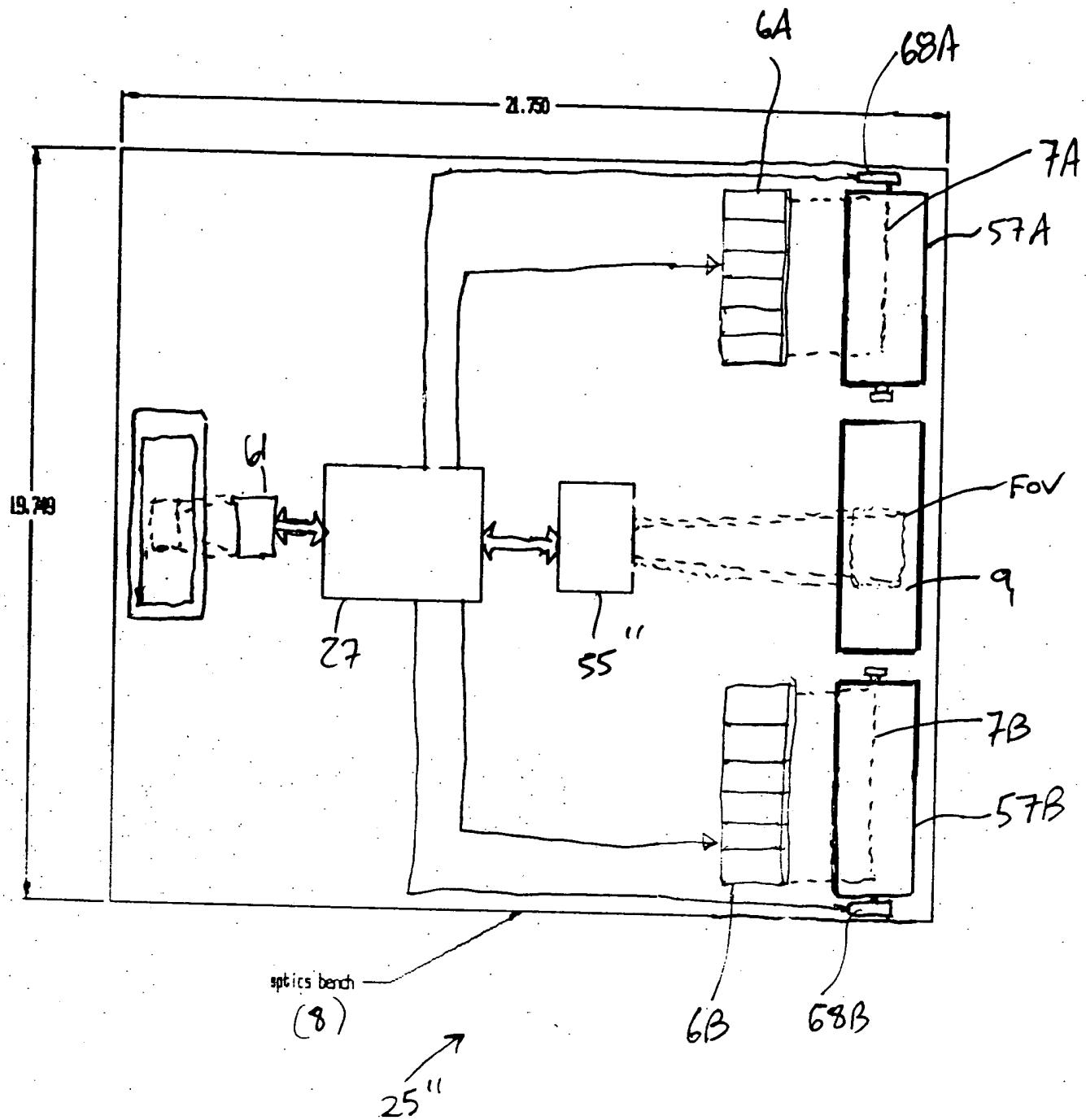


FIG. 6D2

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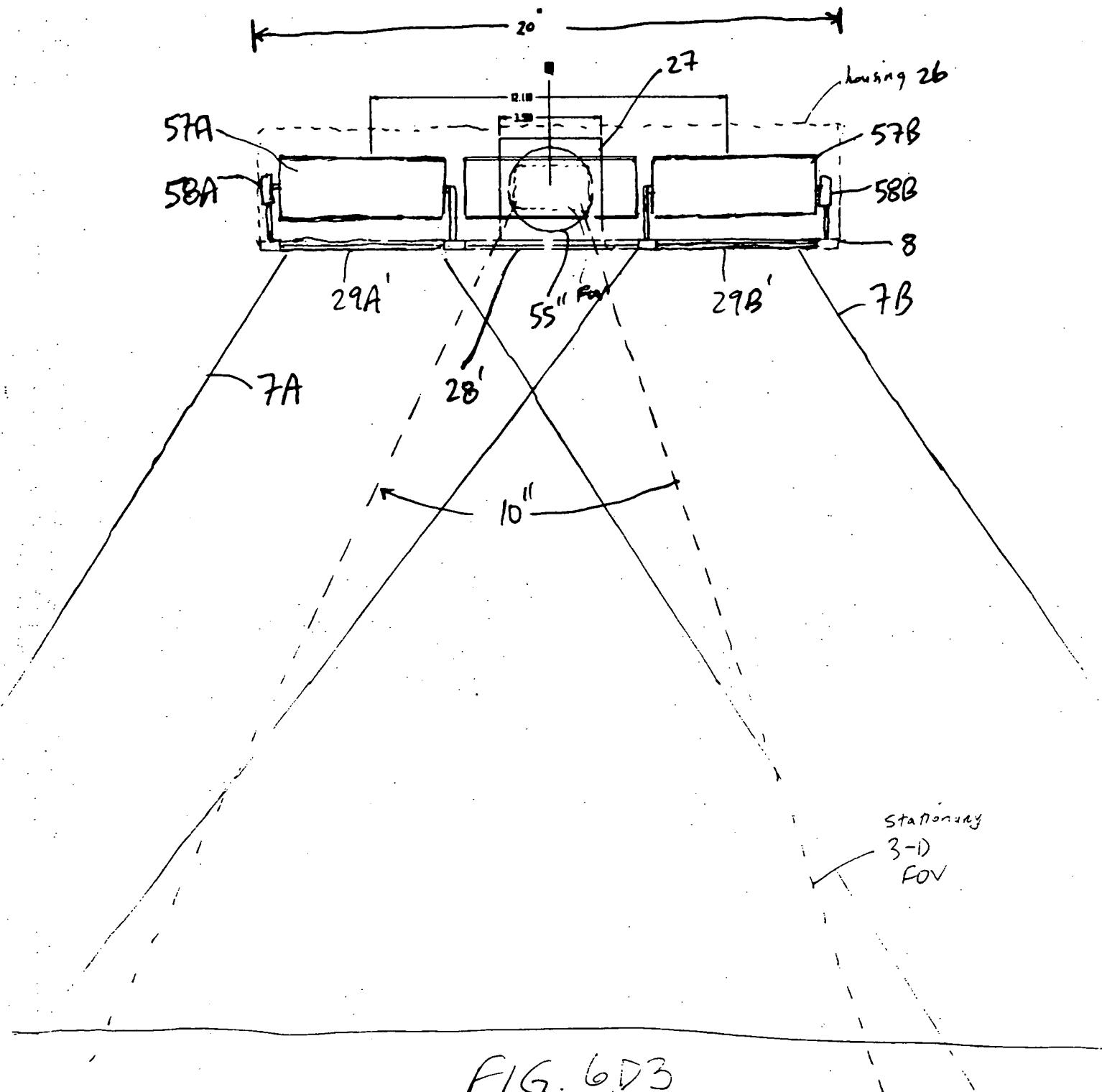


FIG. 6D3

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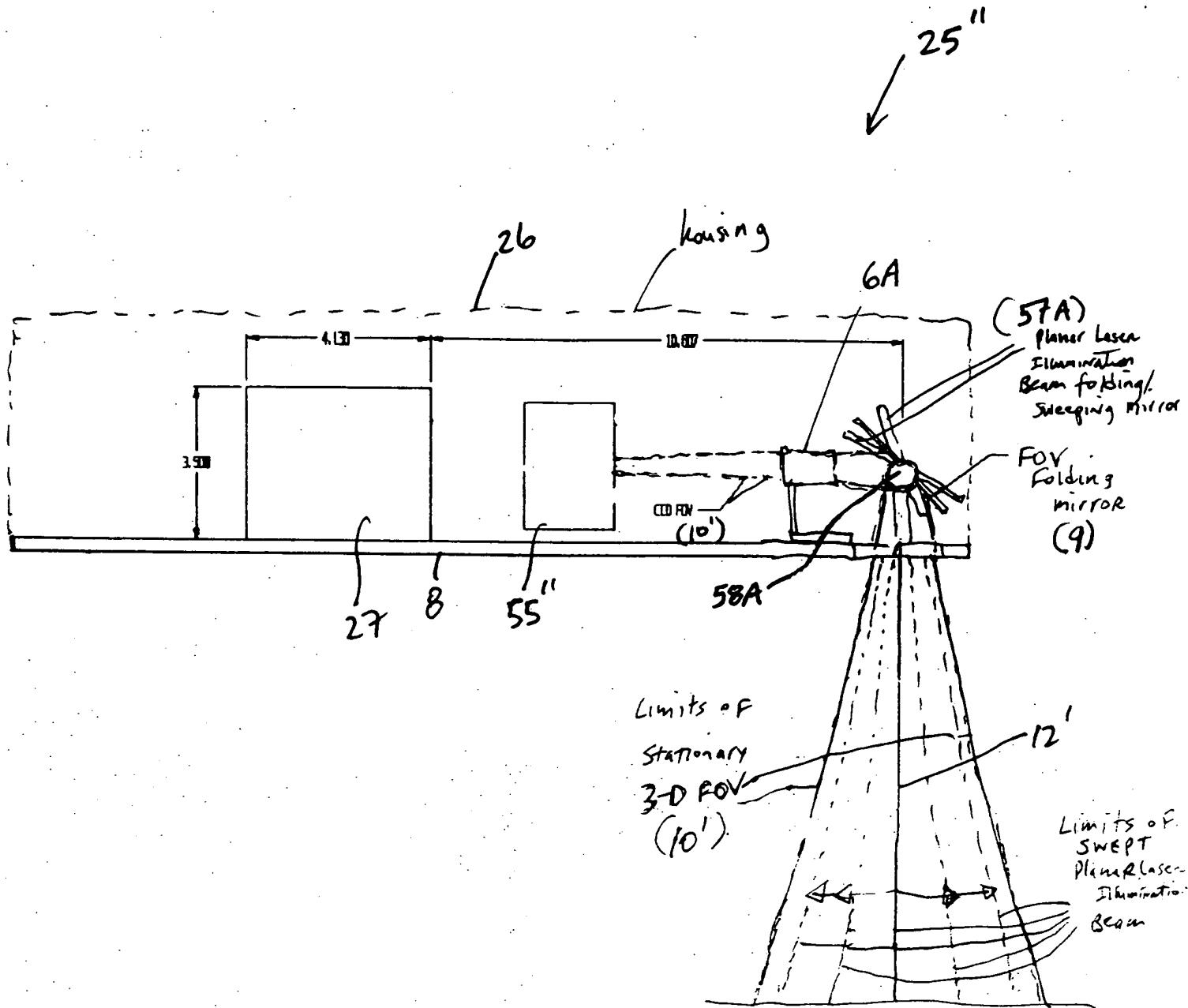


FIG. 6D4

Variable FOV

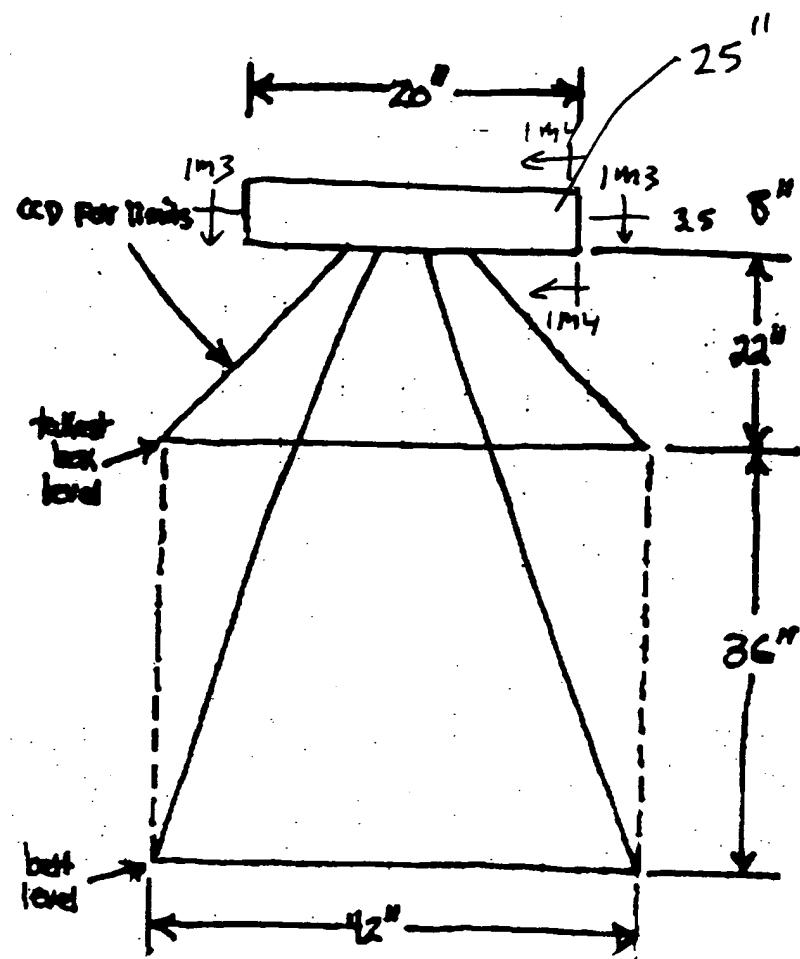


FIG. 605

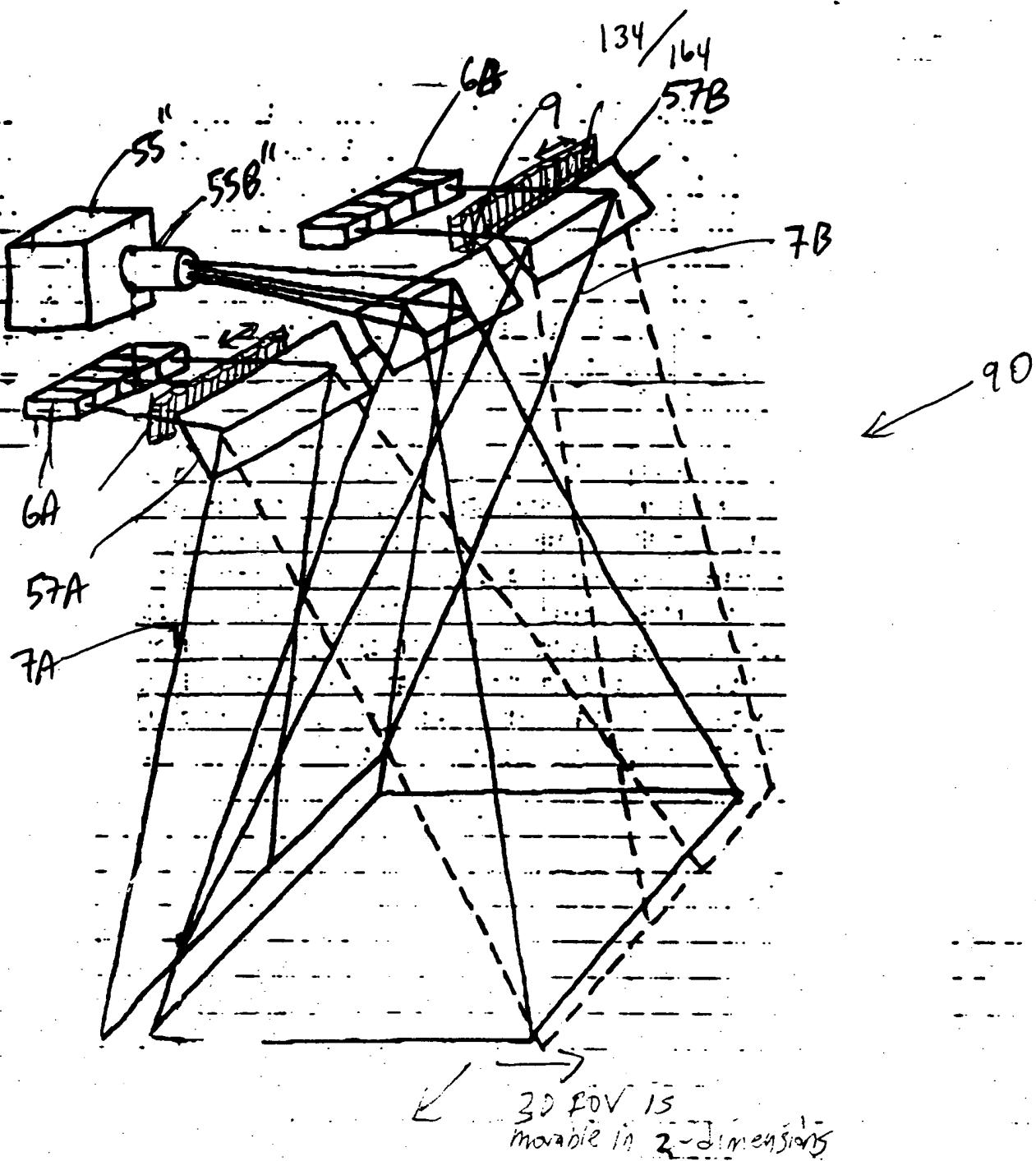


FIG 6E1

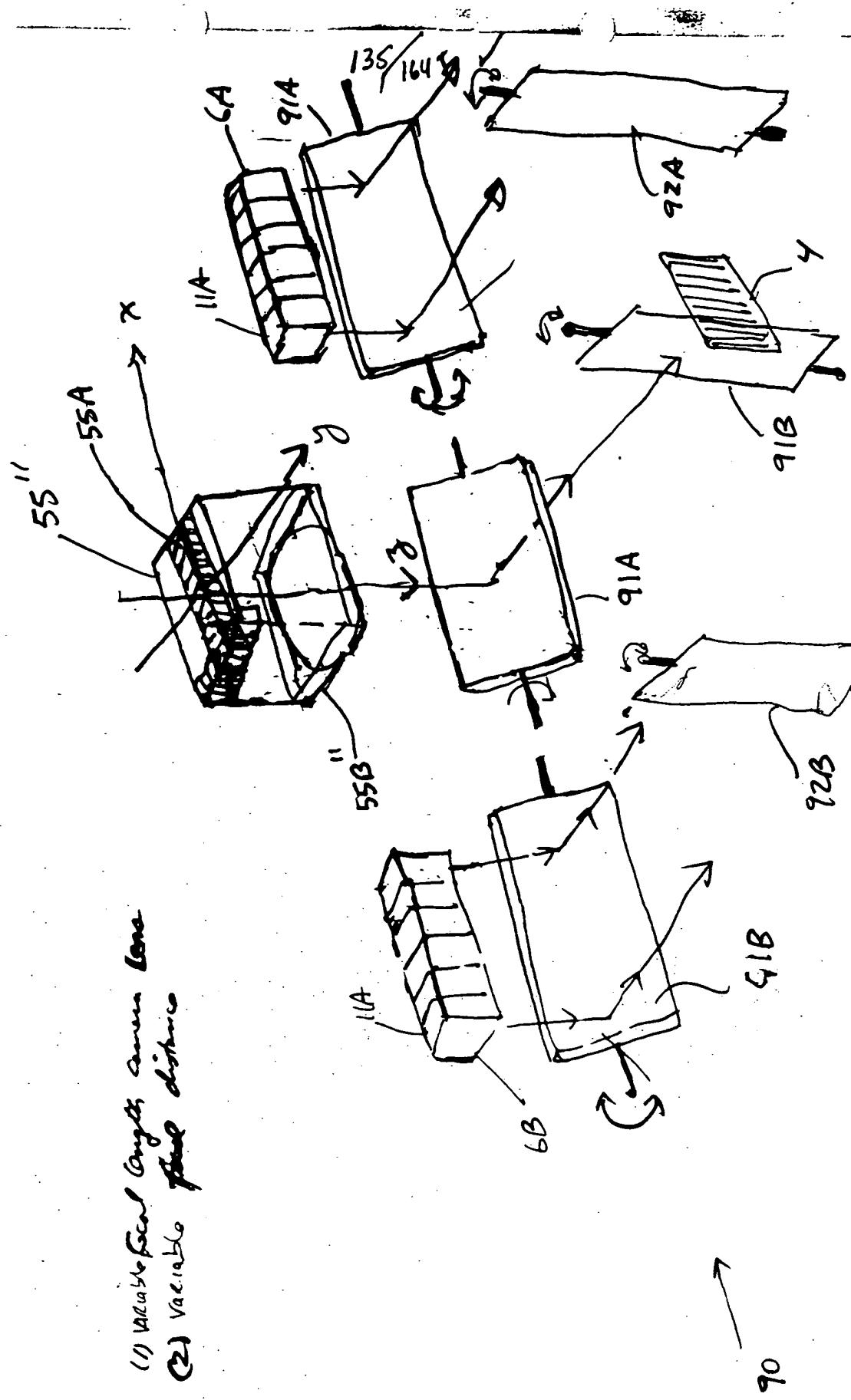


Fig. 6F2

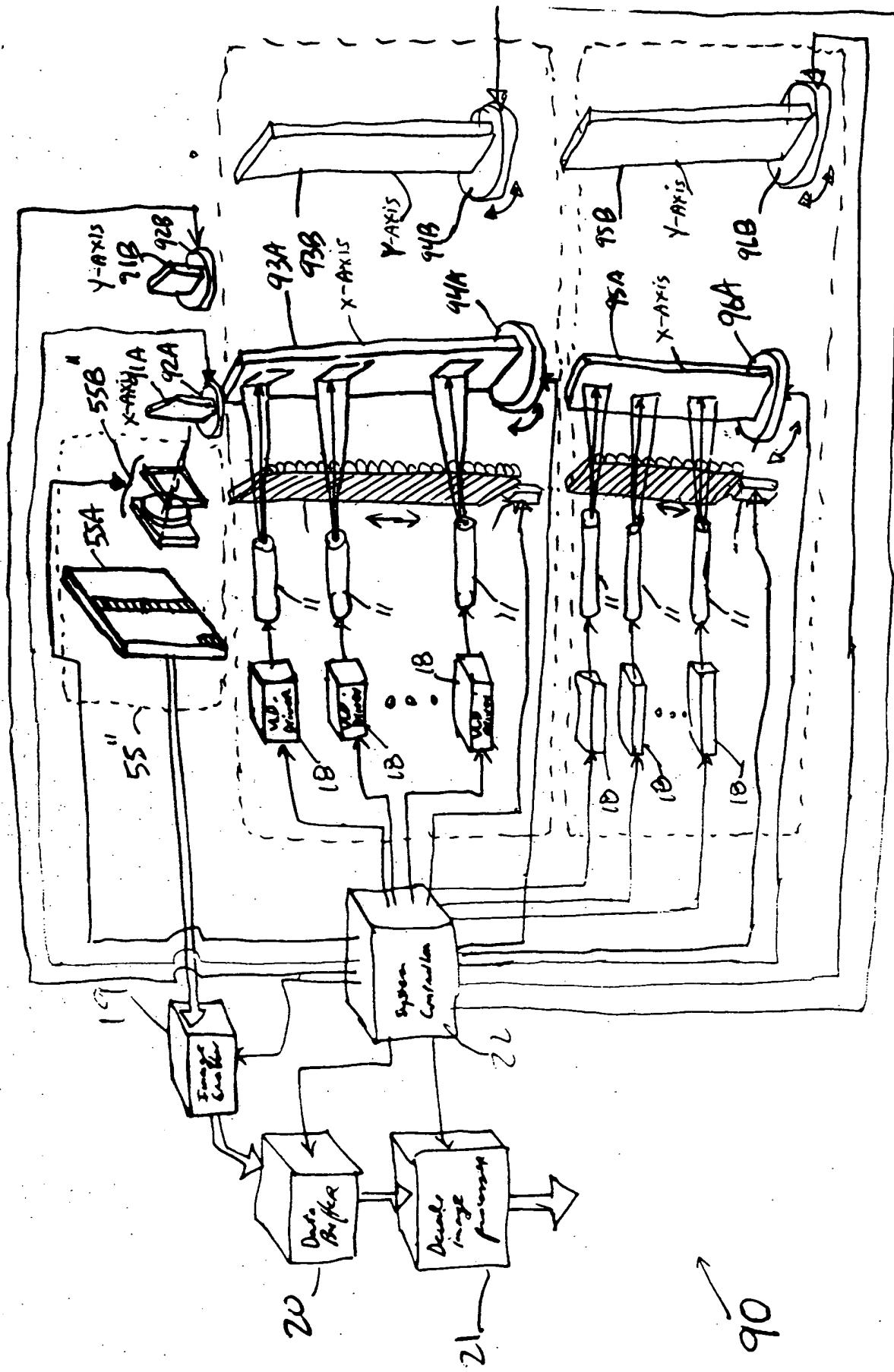
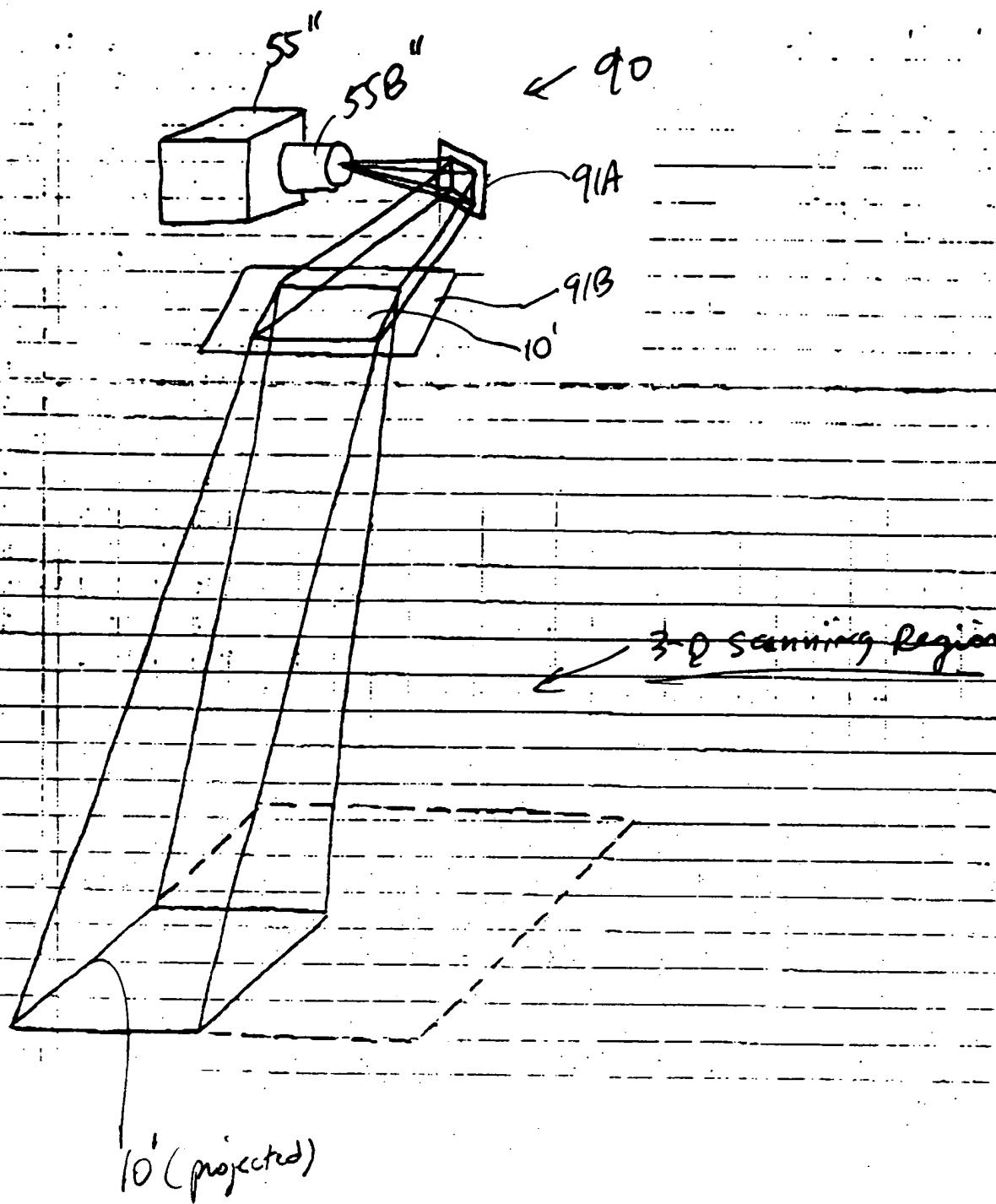


FIG 6E3

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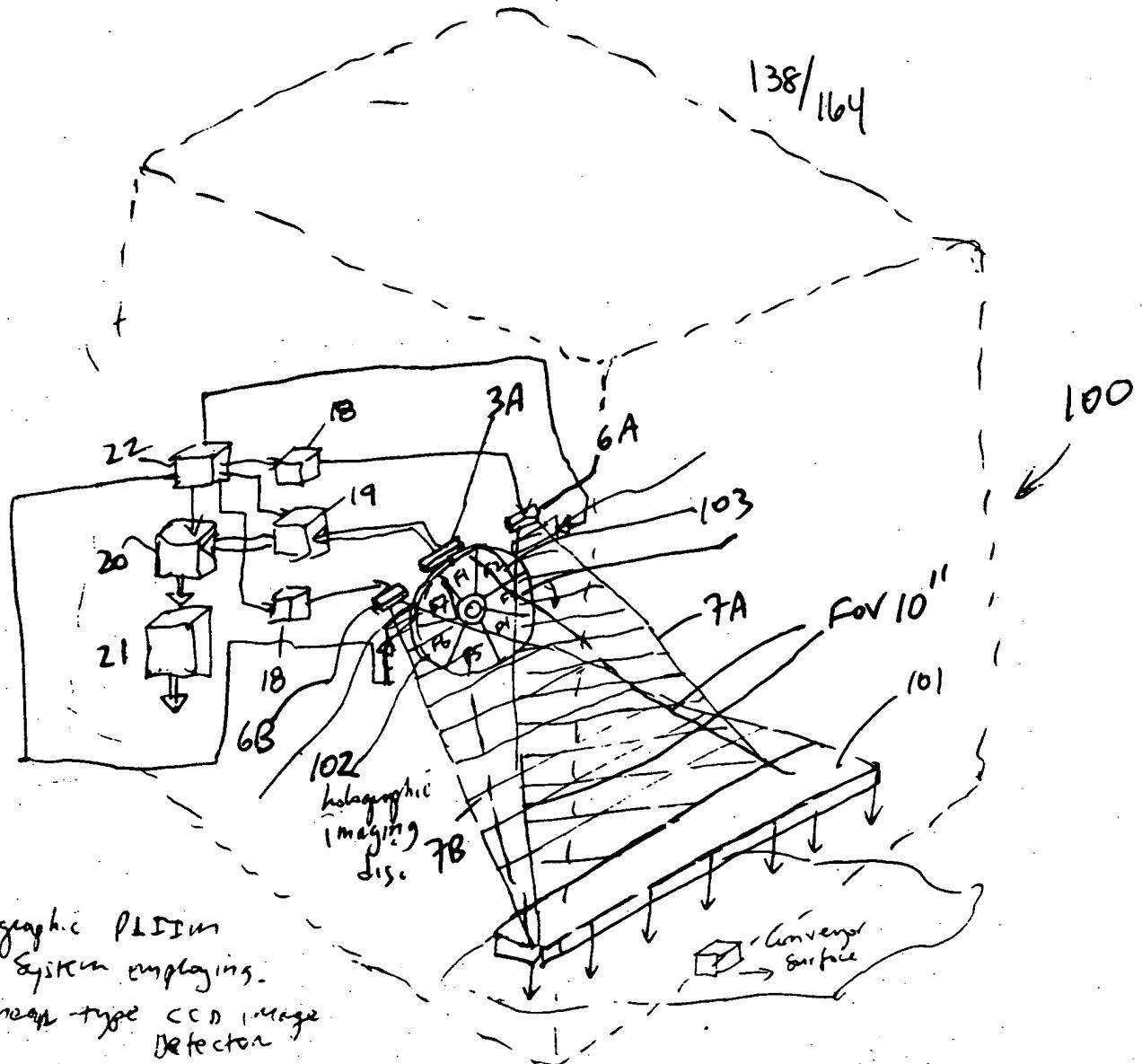


FIG 7A

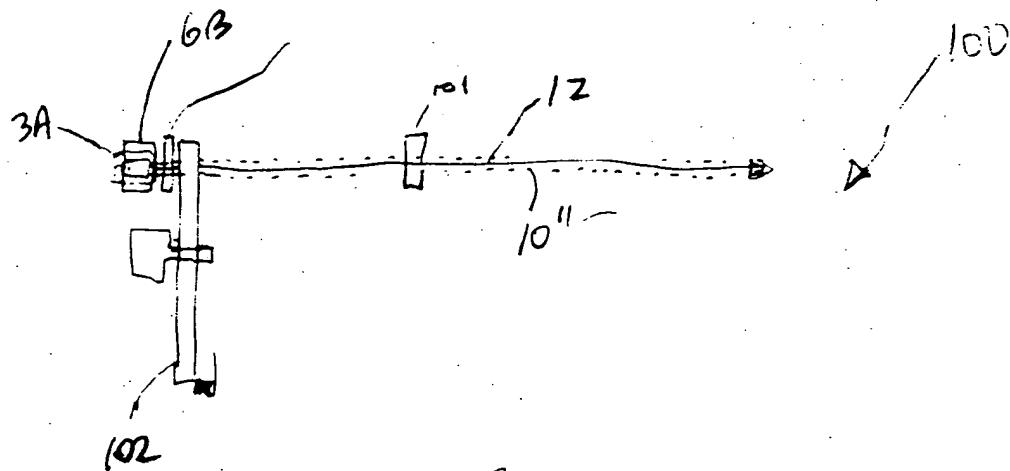
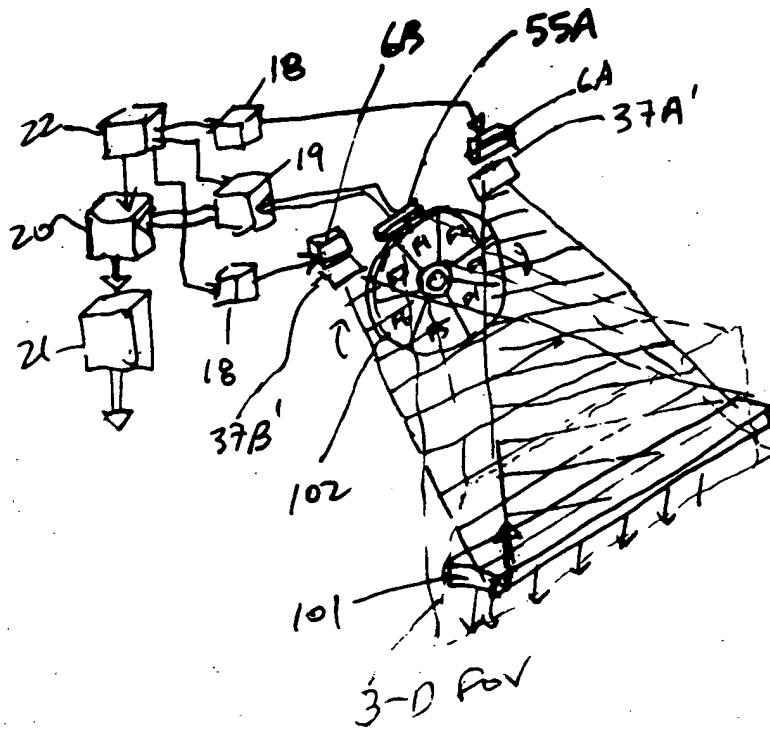


FIG 7B

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Holographic PLIIM
System employing
Area-Type
CCD Image
Detector

100

FIG. 8A

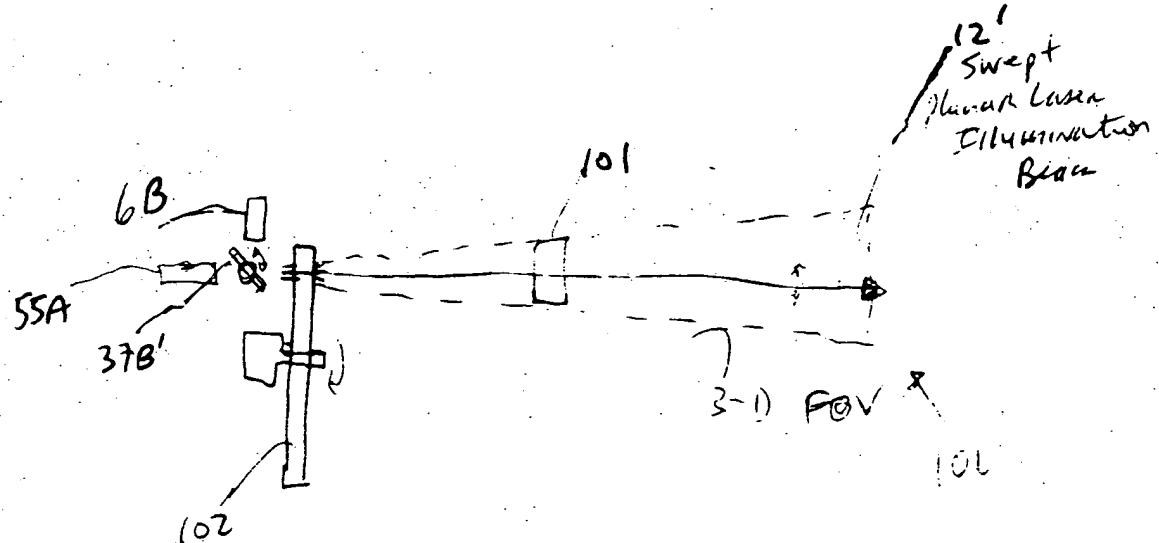


FIG. 8B

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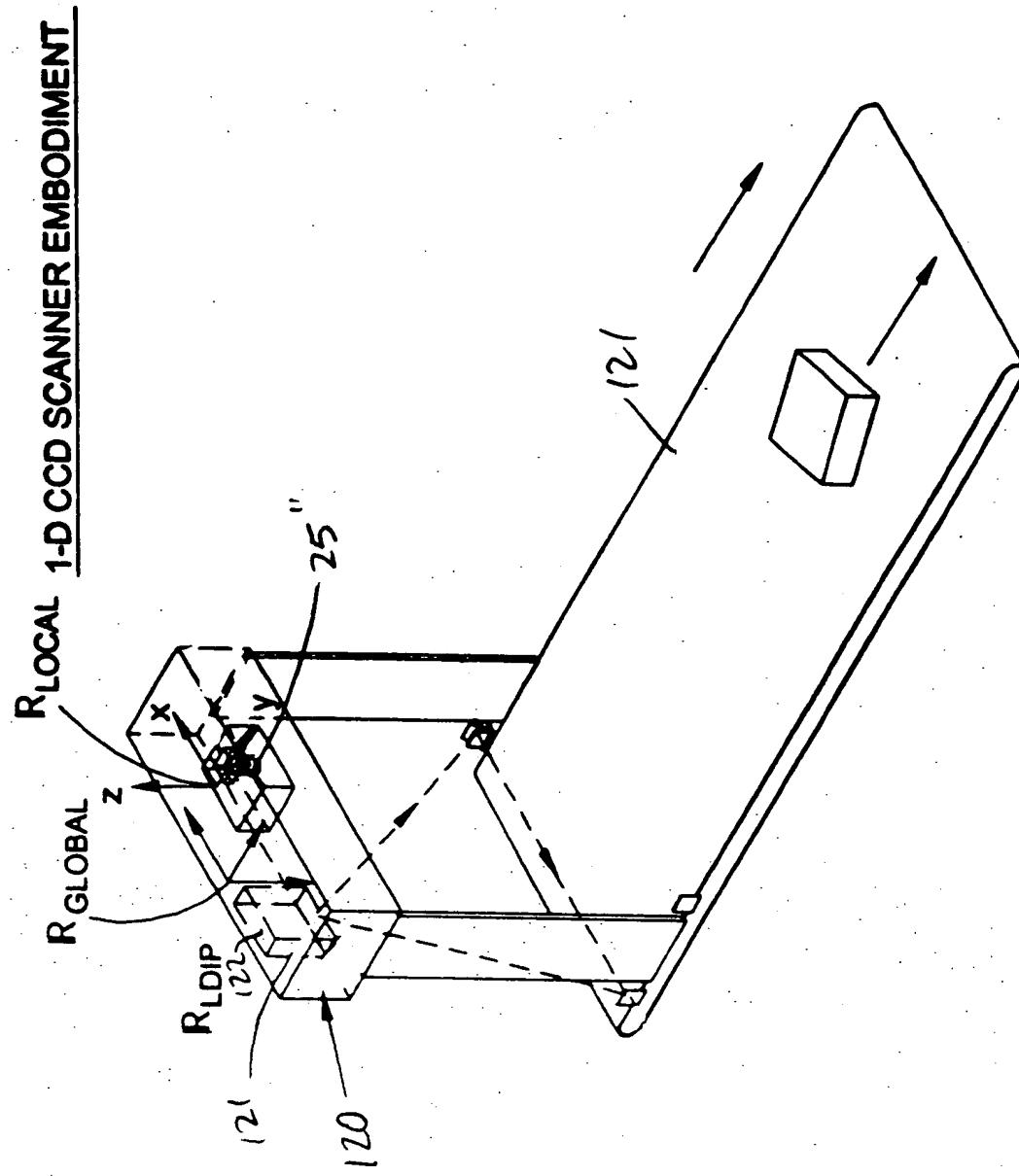


FIG. 9

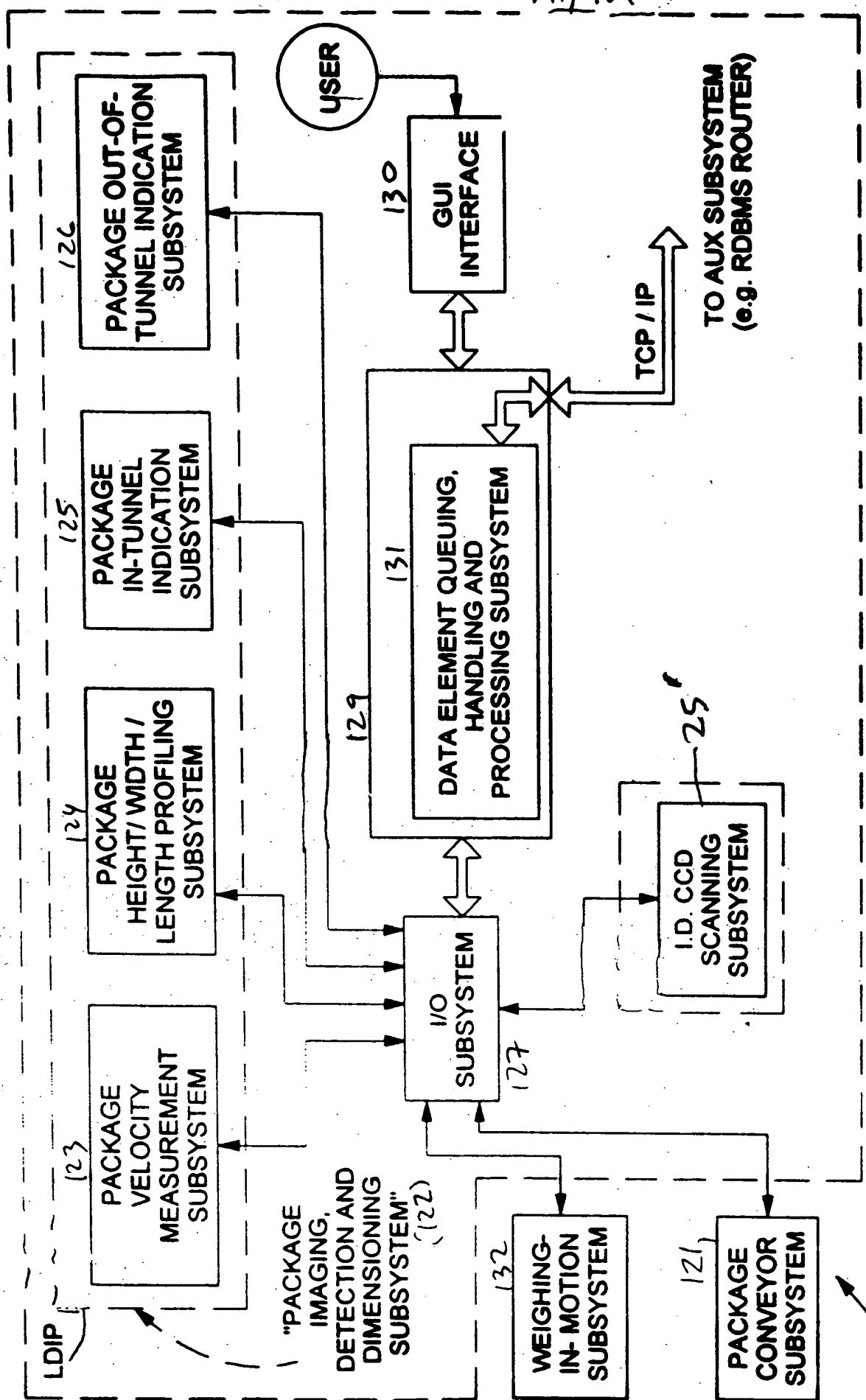
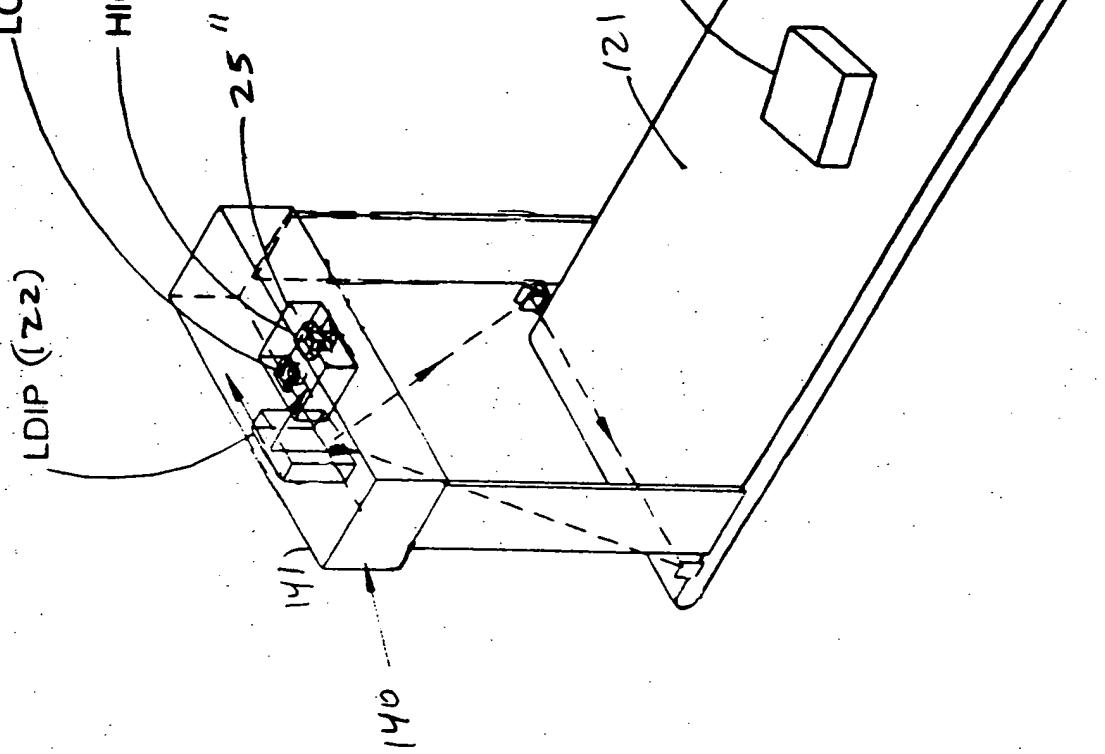


FIG. 10

120

LOW RESOLUTION 2D CCD CAMERA (61)
HIGH RESOLUTION 2D CCD CAMERA (55")



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FIG 11

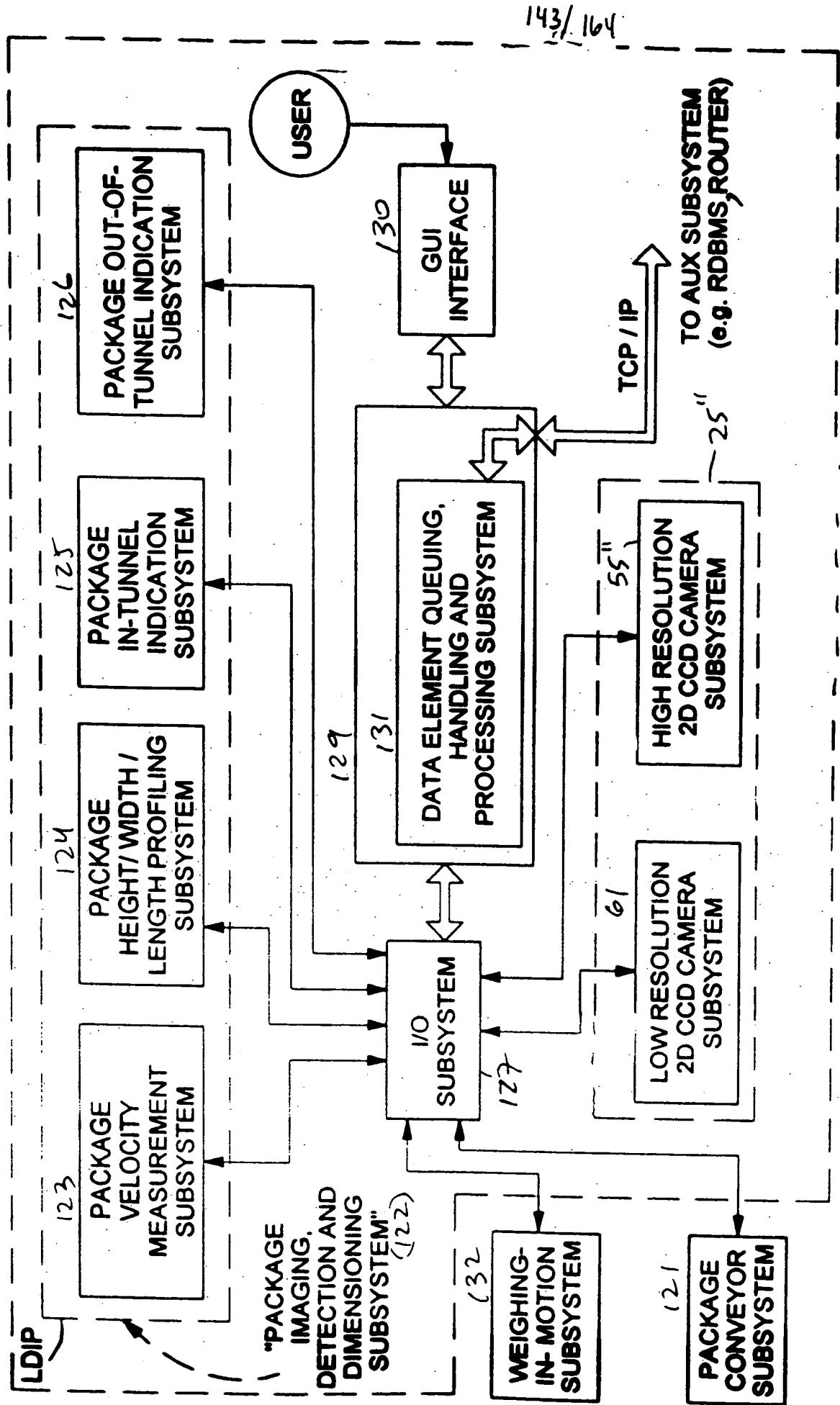


FIG. 12

140

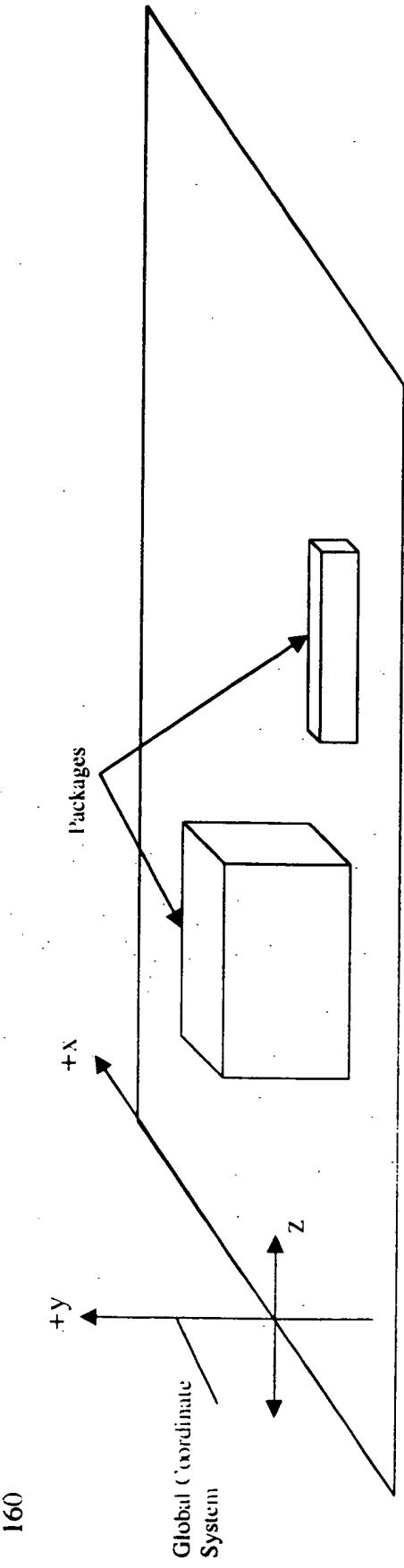
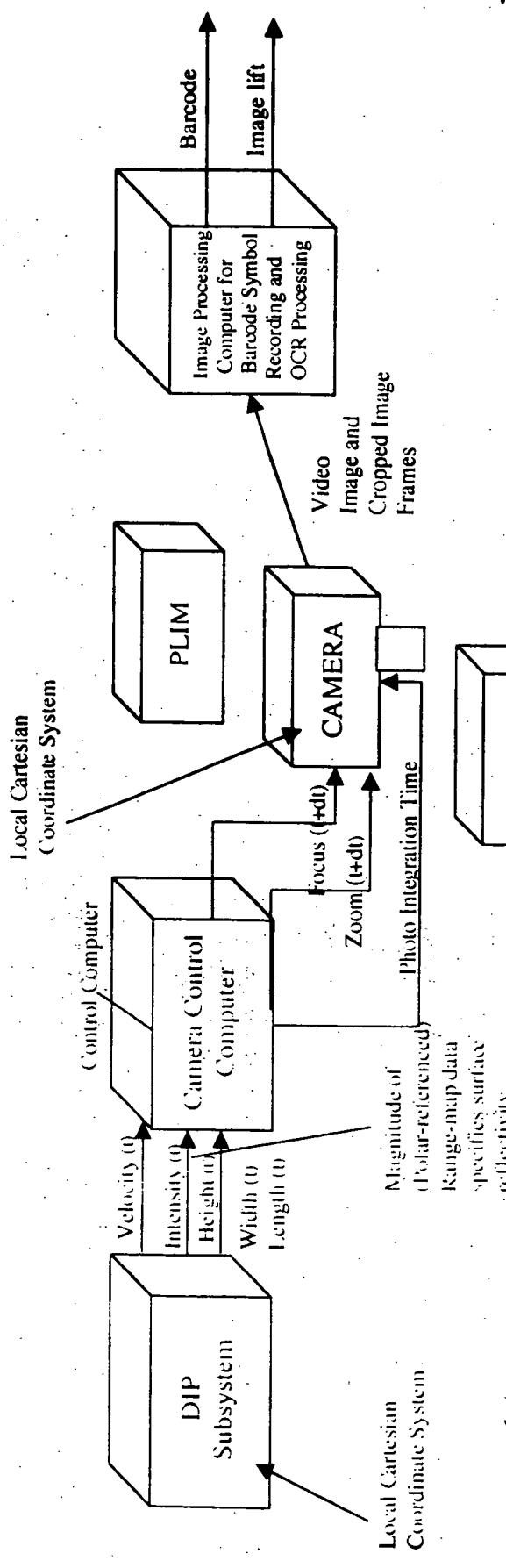


Fig. 13

t+dΔt

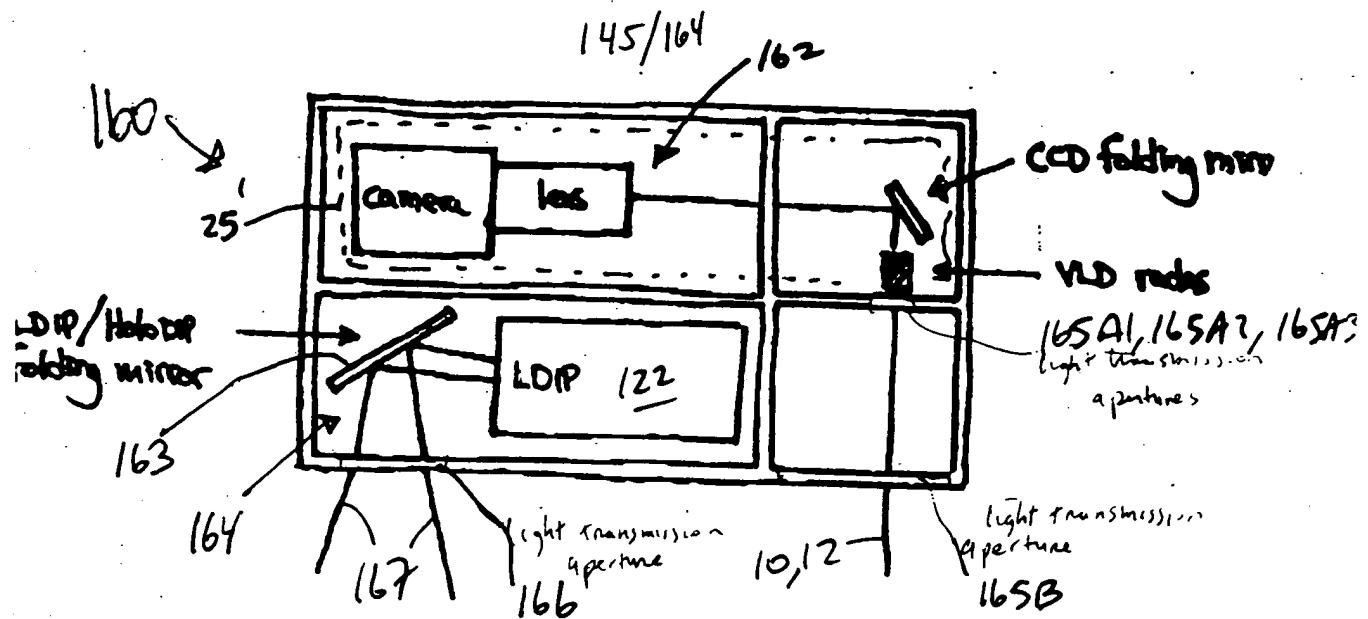


FIG. 14A

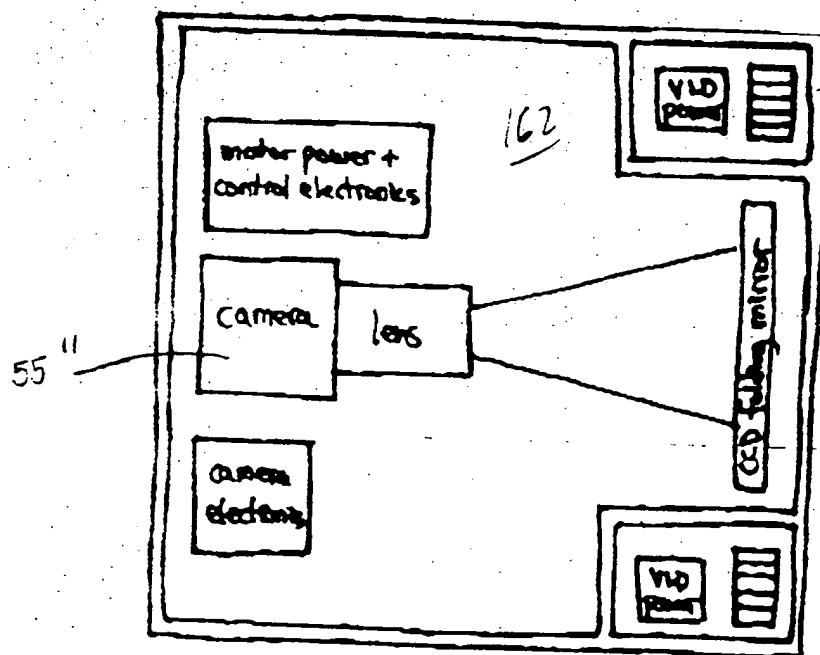
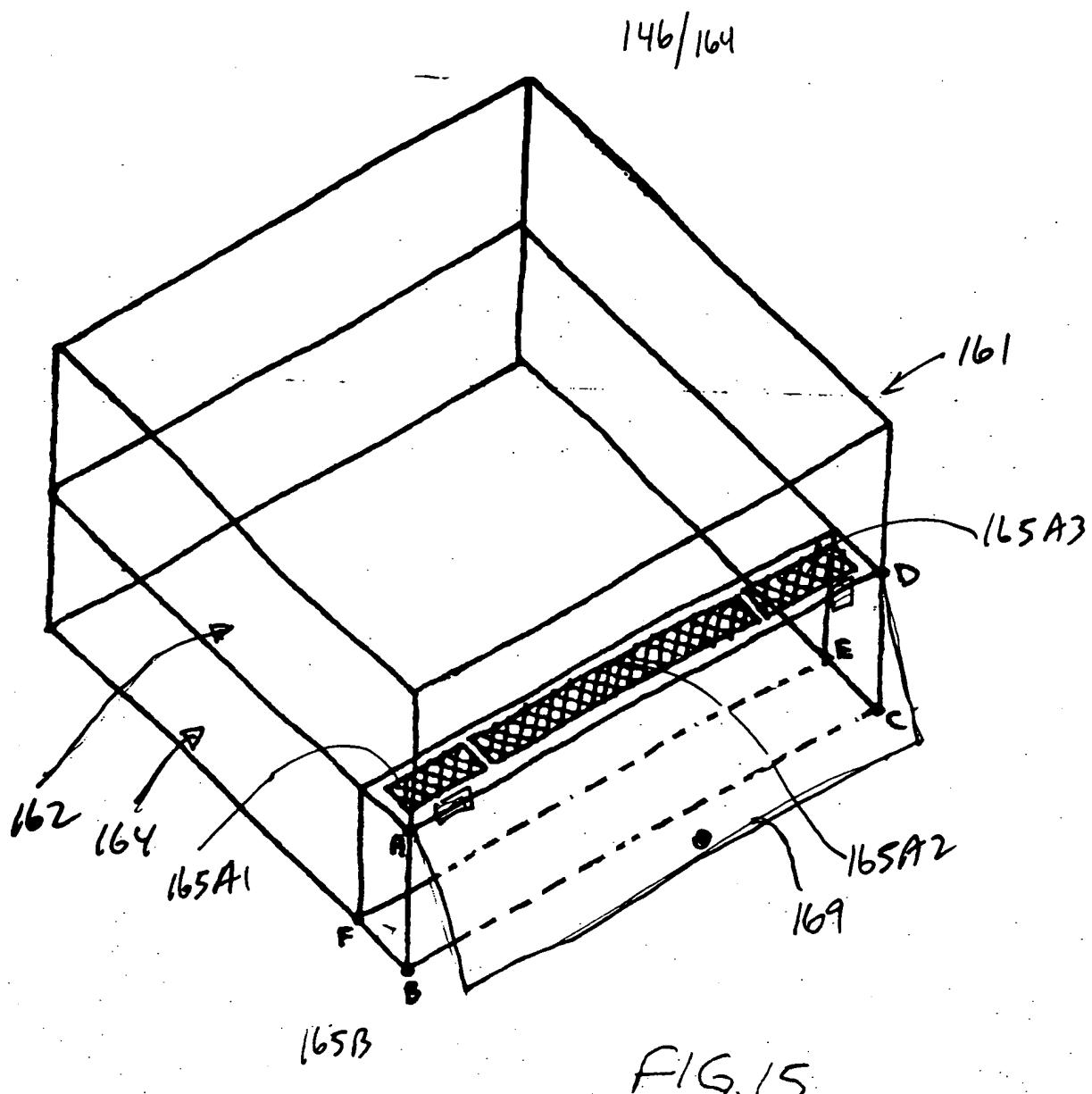


FIG. 14B



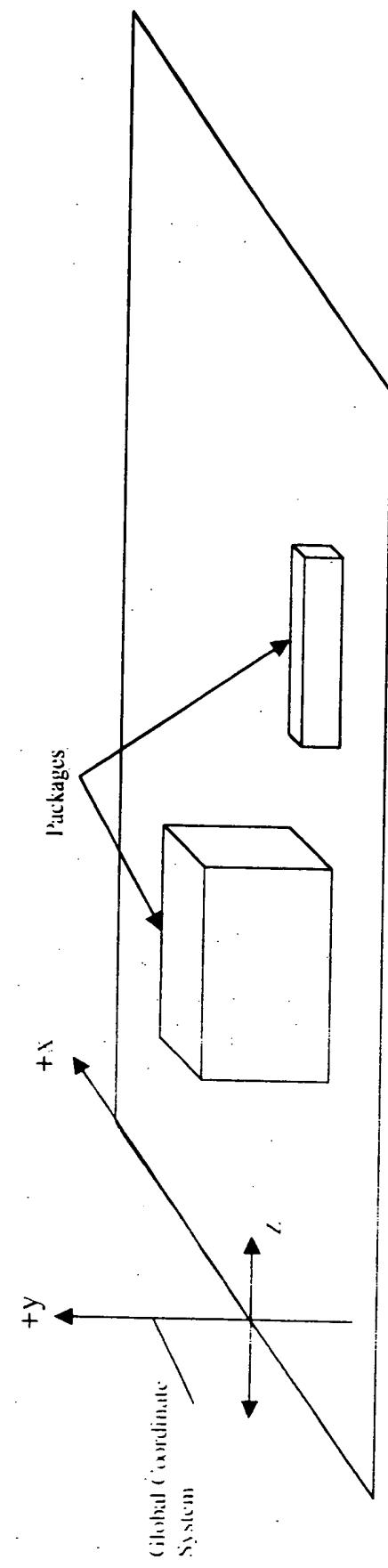
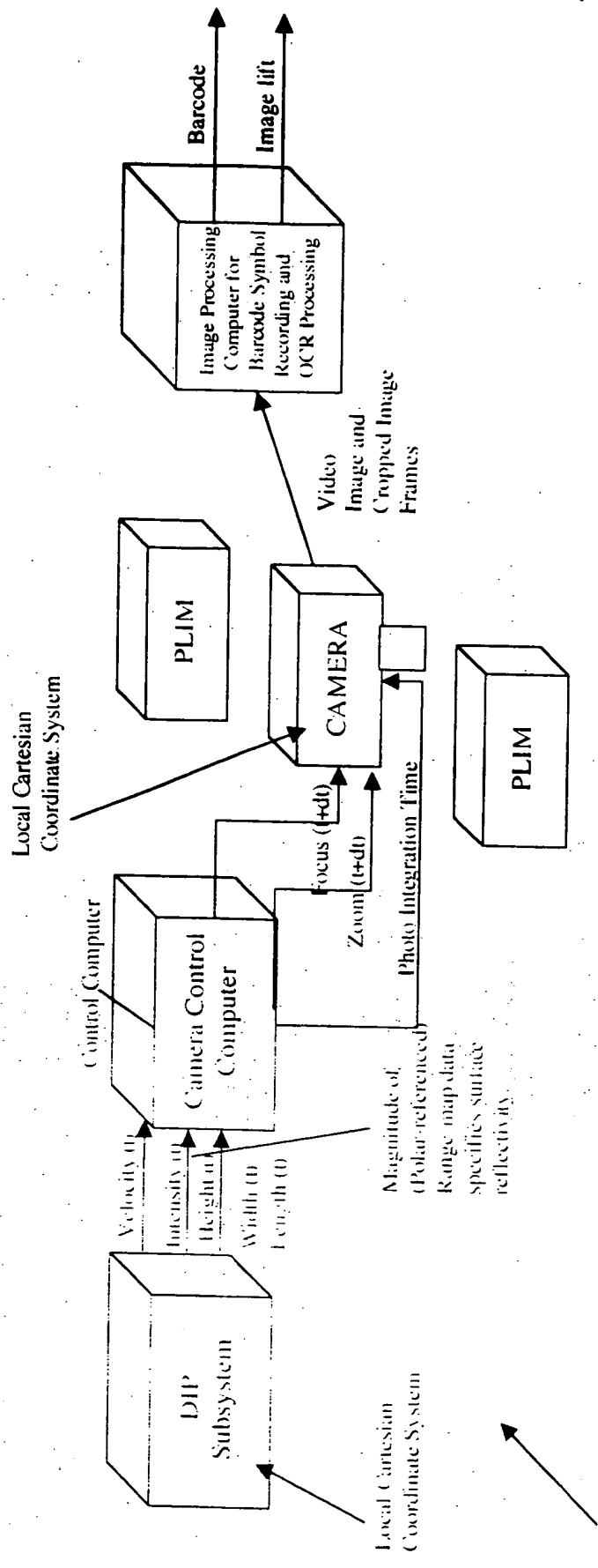


Fig. 16

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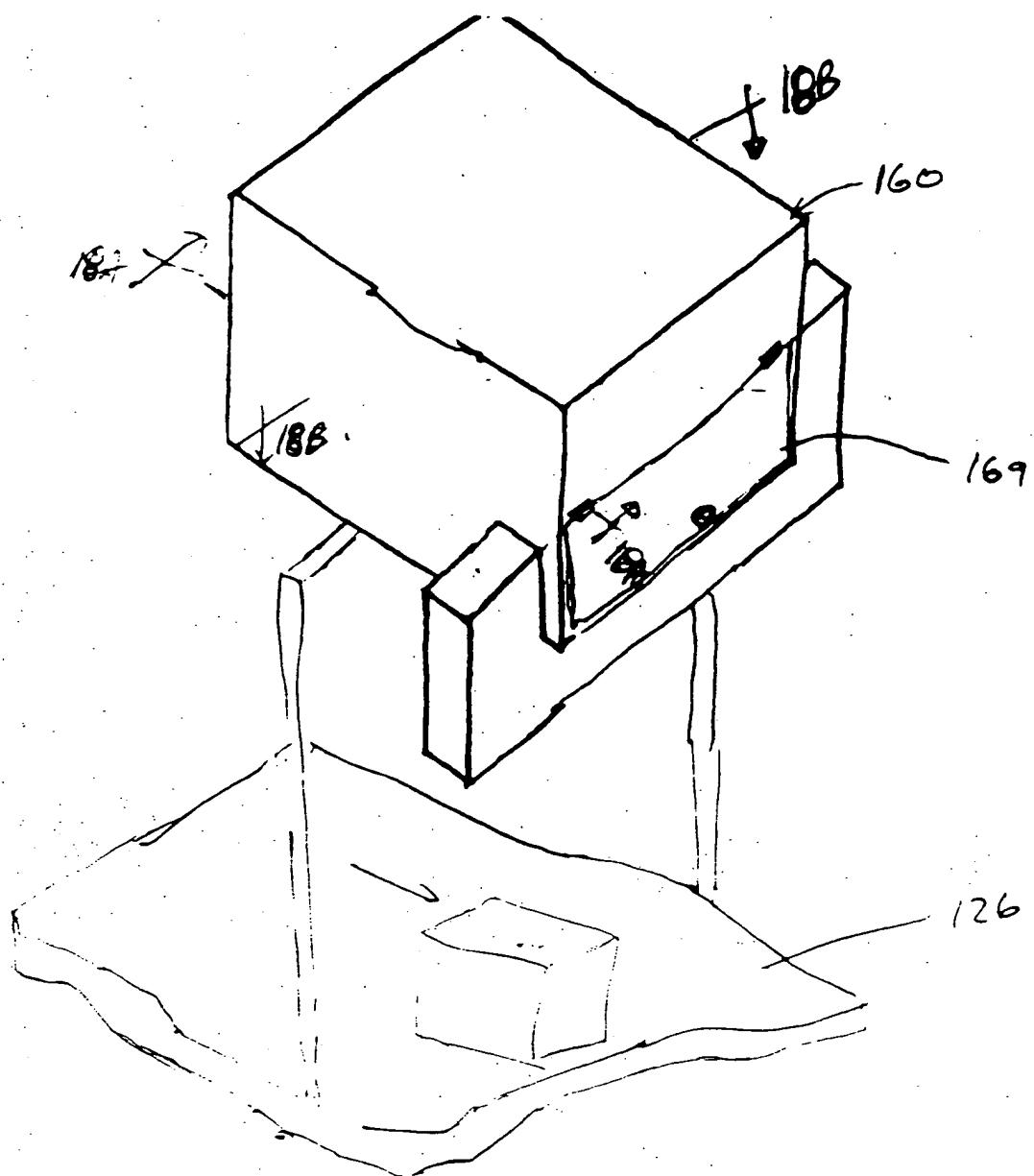


FIG. 17

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upper deck
top view

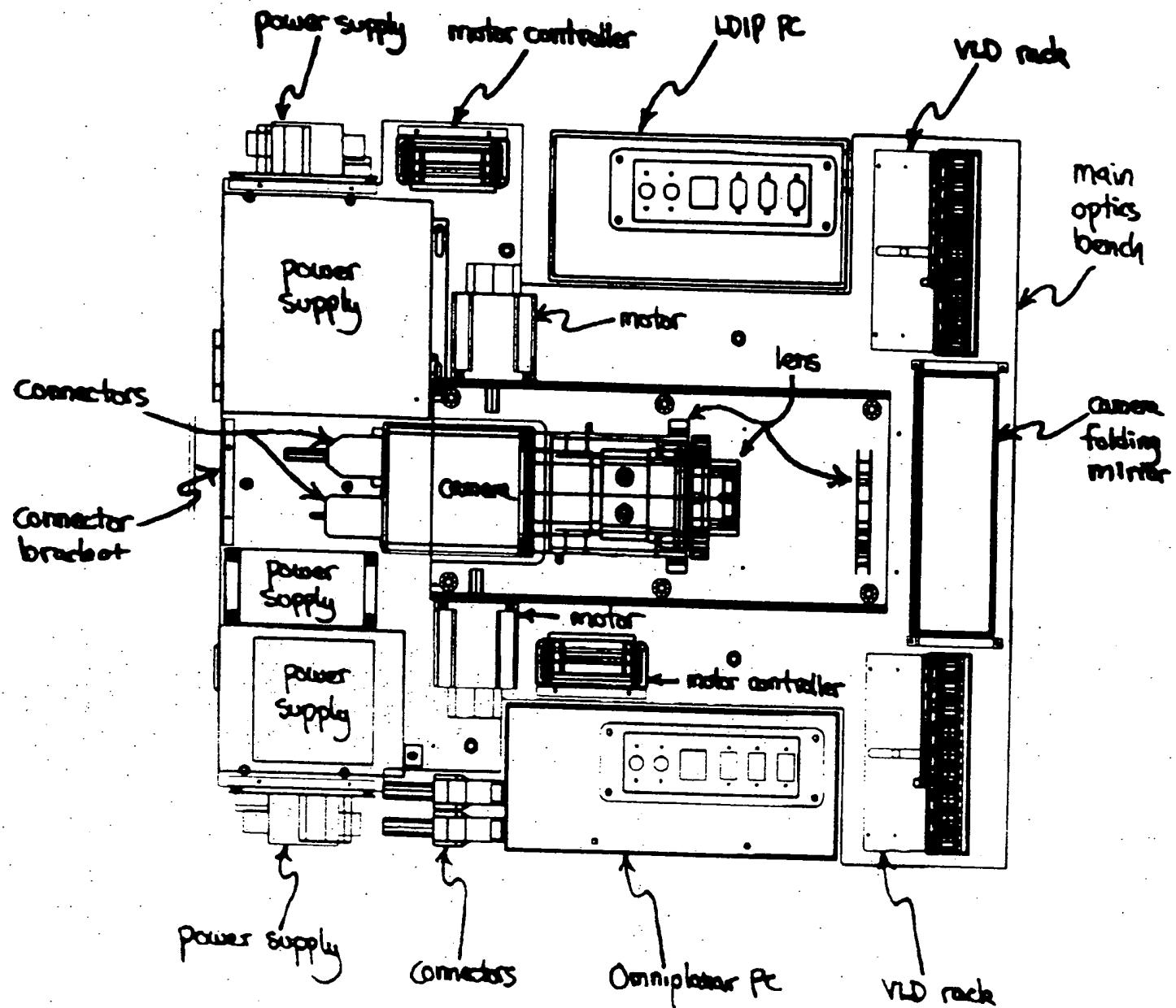


FIG. 18A

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laser deck
top view

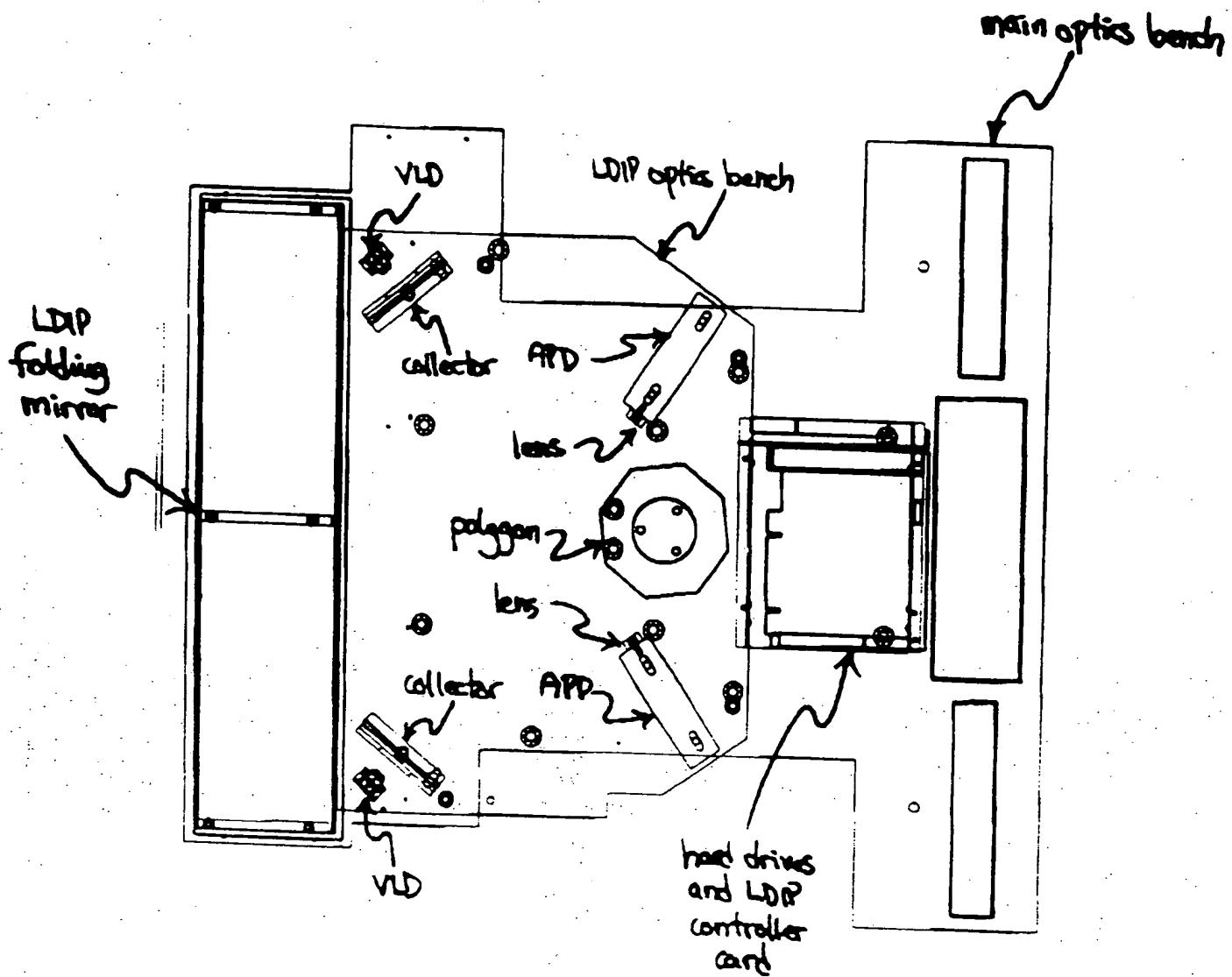
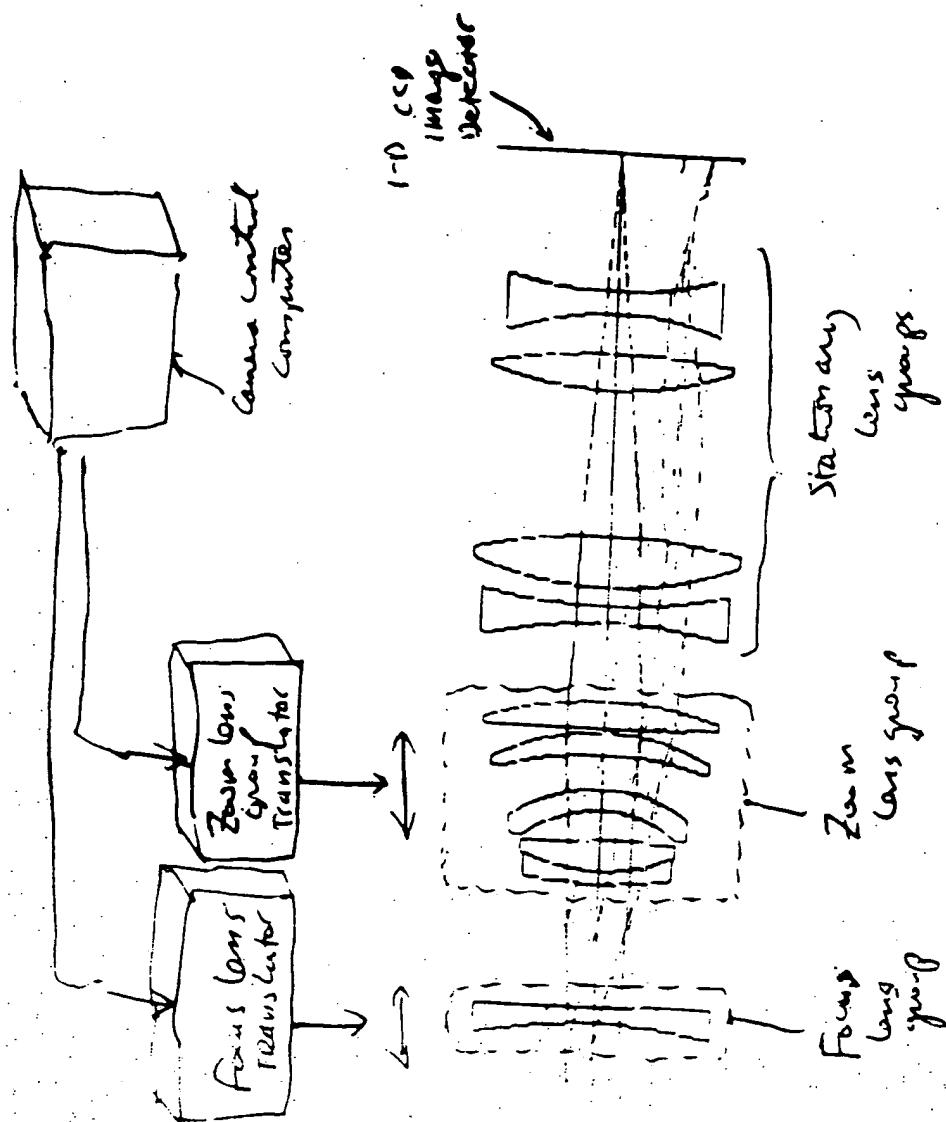


FIG. 18B

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(camera optics)
(lens groups)

FIG 18C

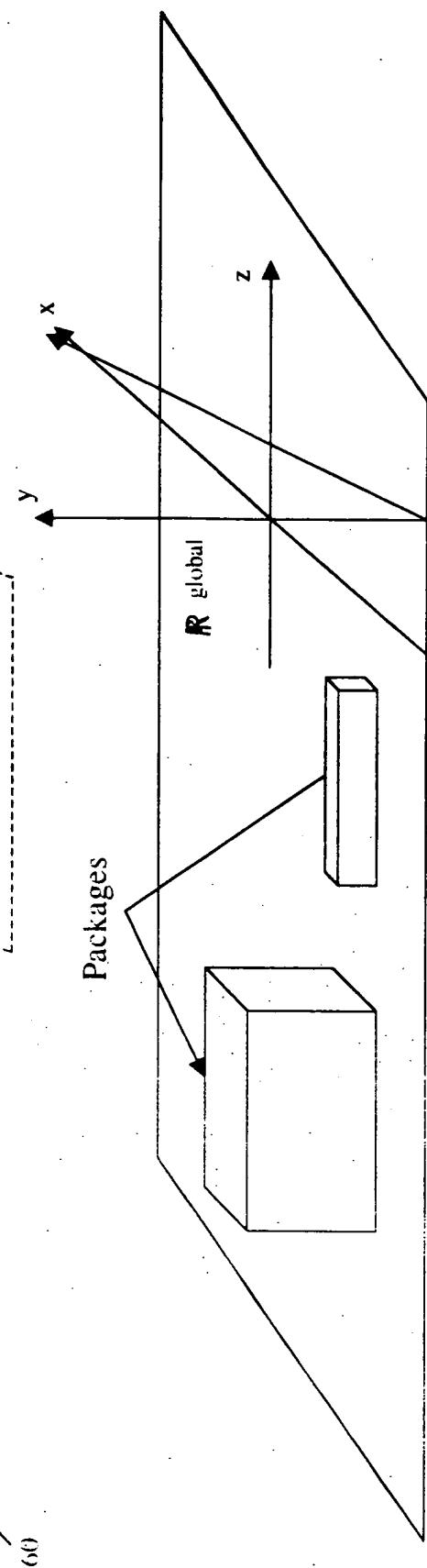
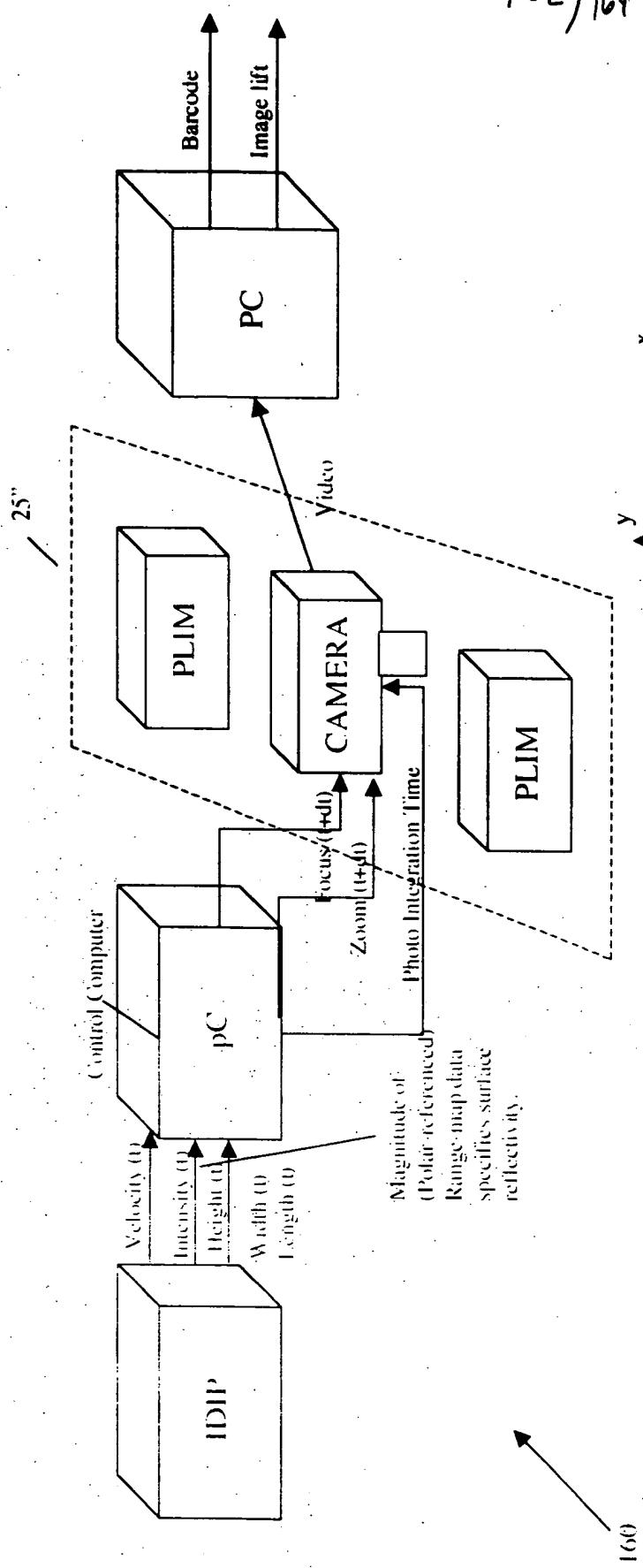


Fig. 19

PLIM-BASED PACKAGE IDENTIFICATION AND DIMENSIONING (PID) SYSTEM

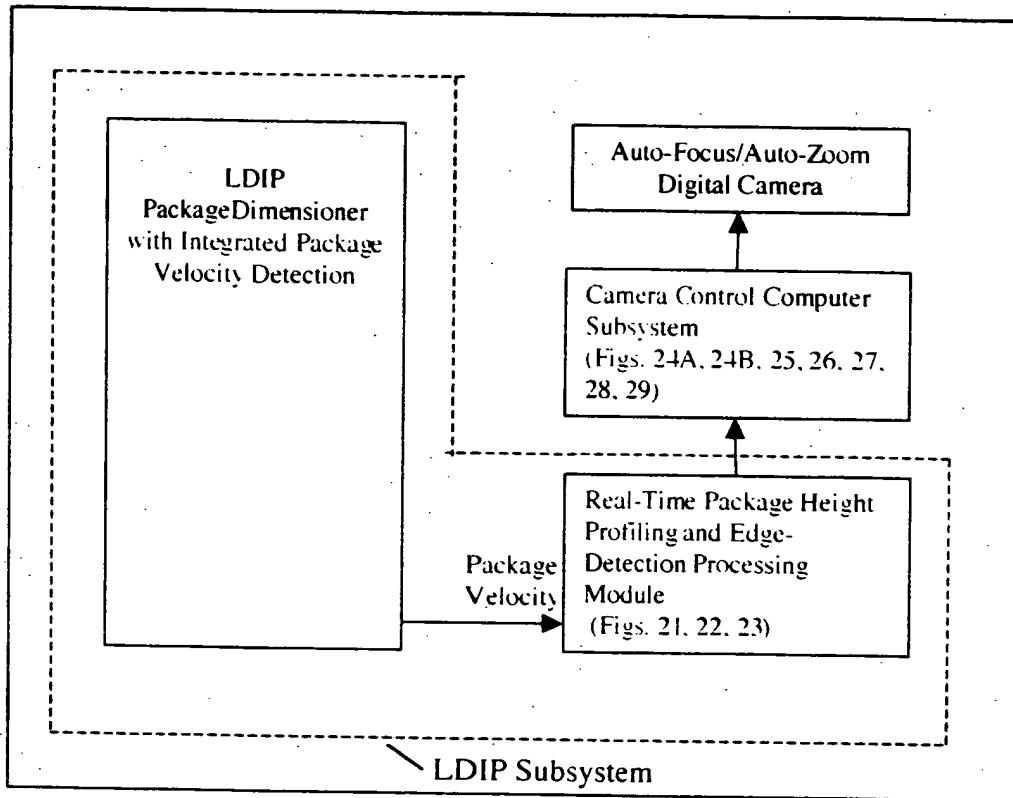


Fig. 20

LDIP REAL-TIME PACKAGE HEIGHT PROFILE AND EDGE DETECTION METHOD

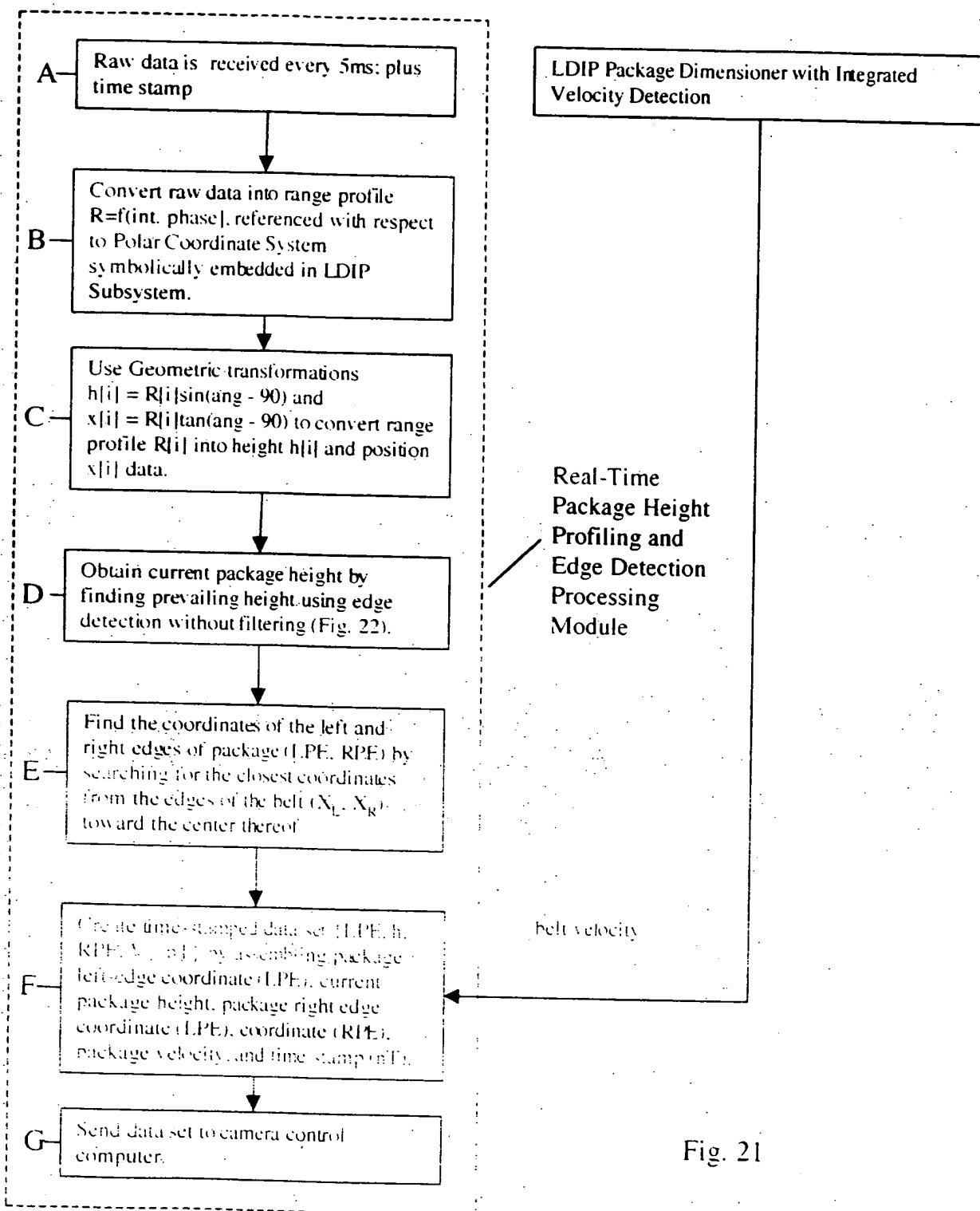
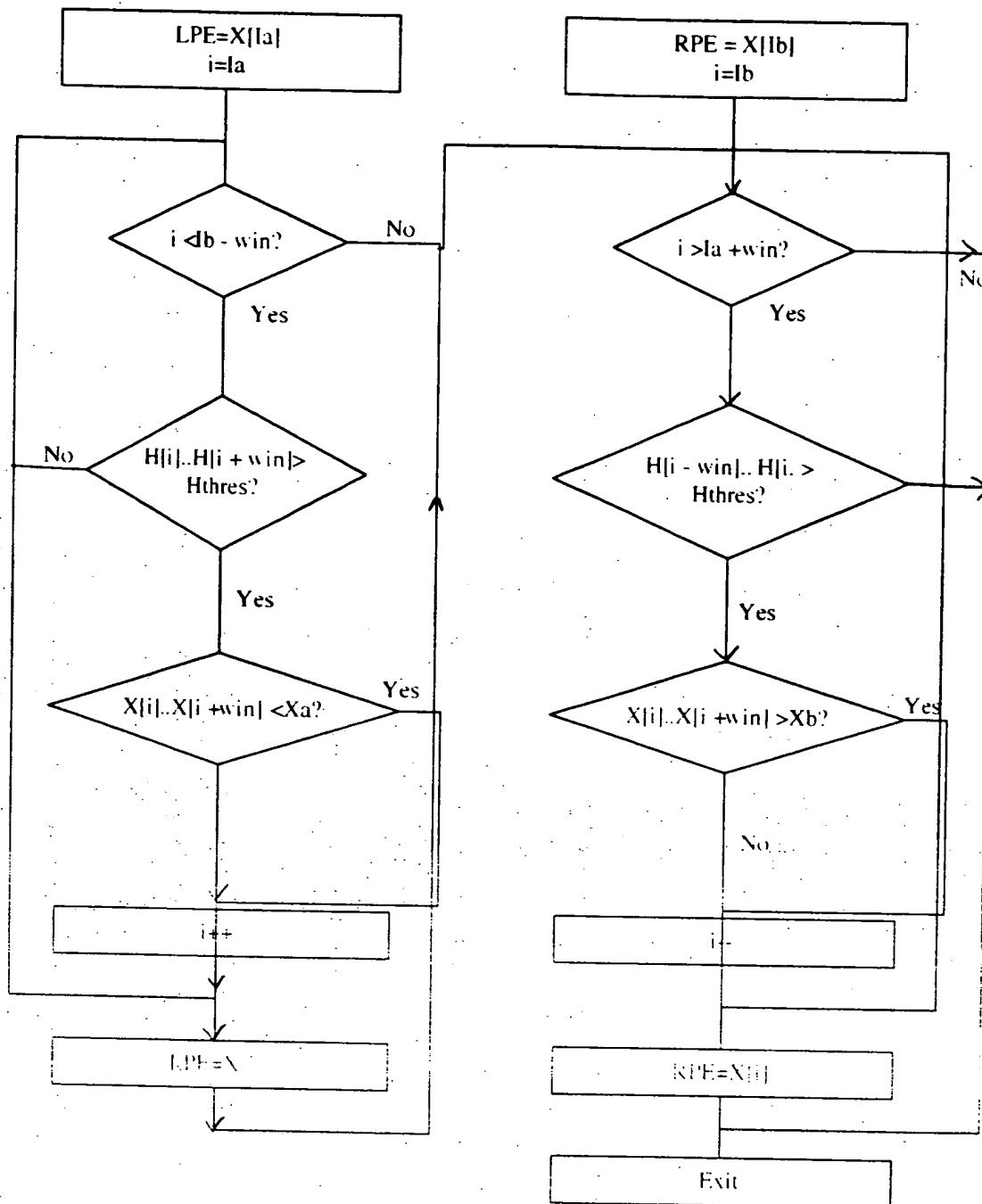


Fig. 21

REAL-TIME PACKAGE EDGE DETECTION METHOD



X_a = location of belt left edge; X_b = location of belt right edge
 i_a = belt left edge pixel; i_b = belt right edge pixel
 LPE = Left package edge; RPE = Right package edge
 $H[]$ = Pixel height array; $X[]$ = Pixel location array
 win = package detection window

Fig. 22

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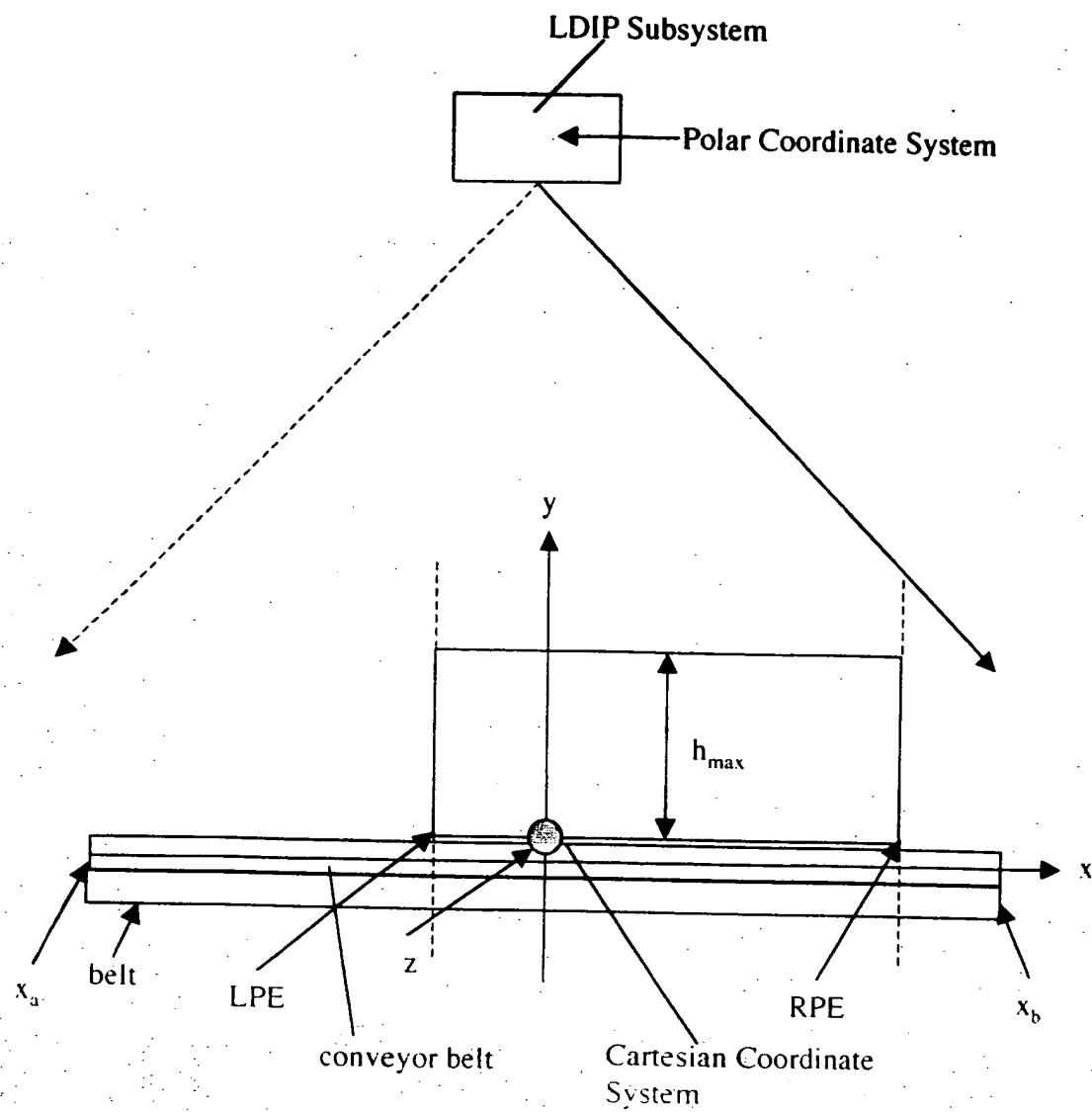


Fig. 23

CAMERA CONTROL PROCESS CARRIED OUT WITHIN THE CAMERA CONTROL SUBSYSTEM

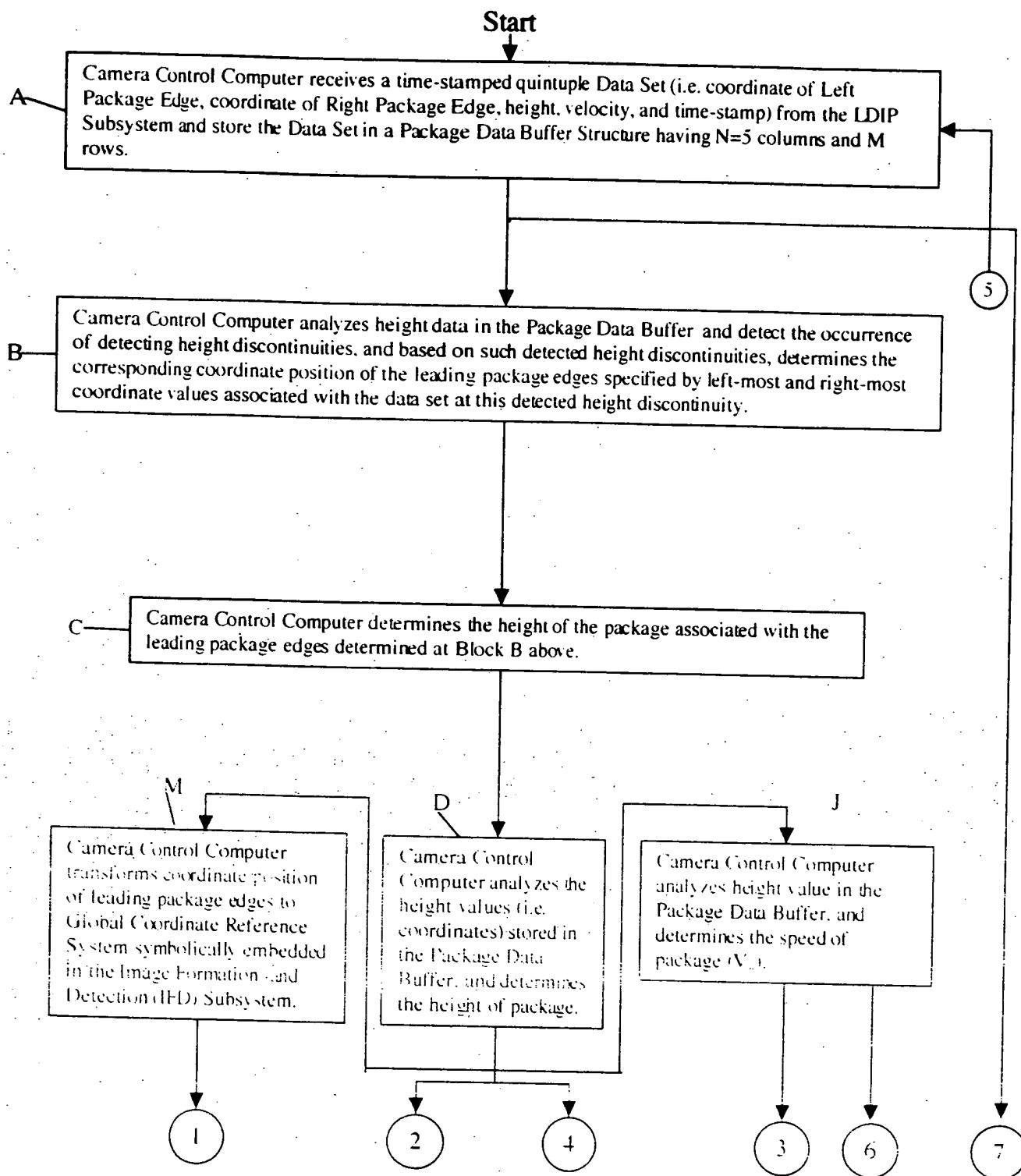


Fig. 24A

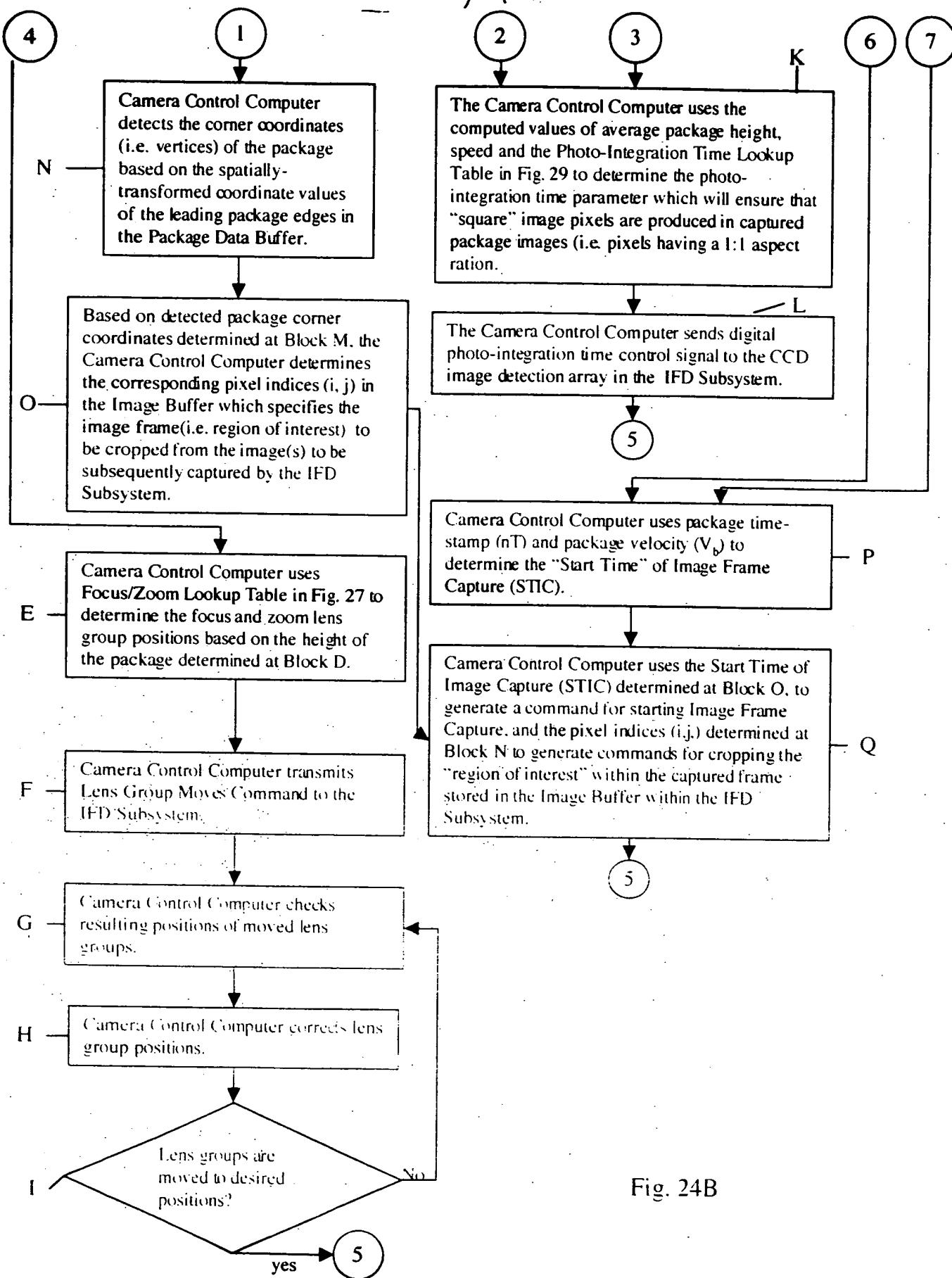


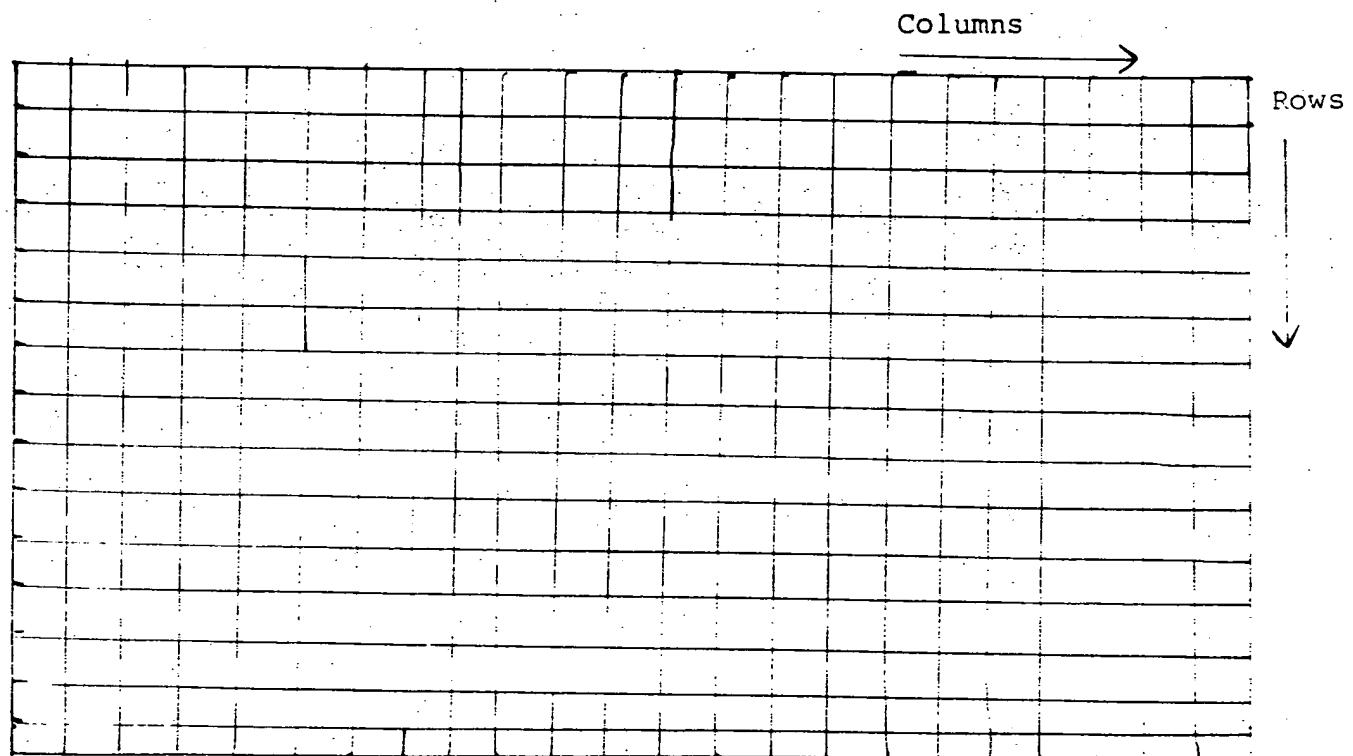
Fig. 24B

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Left Package Edge (LDE)	Package Height (h)	Right Package Edge (RPE)	Package Velocity	Time-stamp (nT)
				Row 1
				Row 2
				Row 3
				Row 4
				Row 5
				Row M

Package Data Buffer (FIFO)

Fig. 25



Camera Pixel Data Buffer
pixel indices (i,j,)

Fig. 26

Zoom and focus lens group position
in 8mm. Tilt

Distance from Camera H (mm)	Zoom group distance (mm) Y (Zoom)	Focus group distance (mm) Y (Focus)
1000	21.57489228	2.47E-05
1100	19.38089696	10.99009783
1200	17.10673434	20.65783177
1300	14.77137314	29.10917002
1400	12.39153565	36.47312595
1500	9.979114358	42.87845436
1600	7.540639114	48.440033358
1700	5.078794775	53.25495831
1800	2.595989366	57.40834303
1900	0.099972739	60.98883615

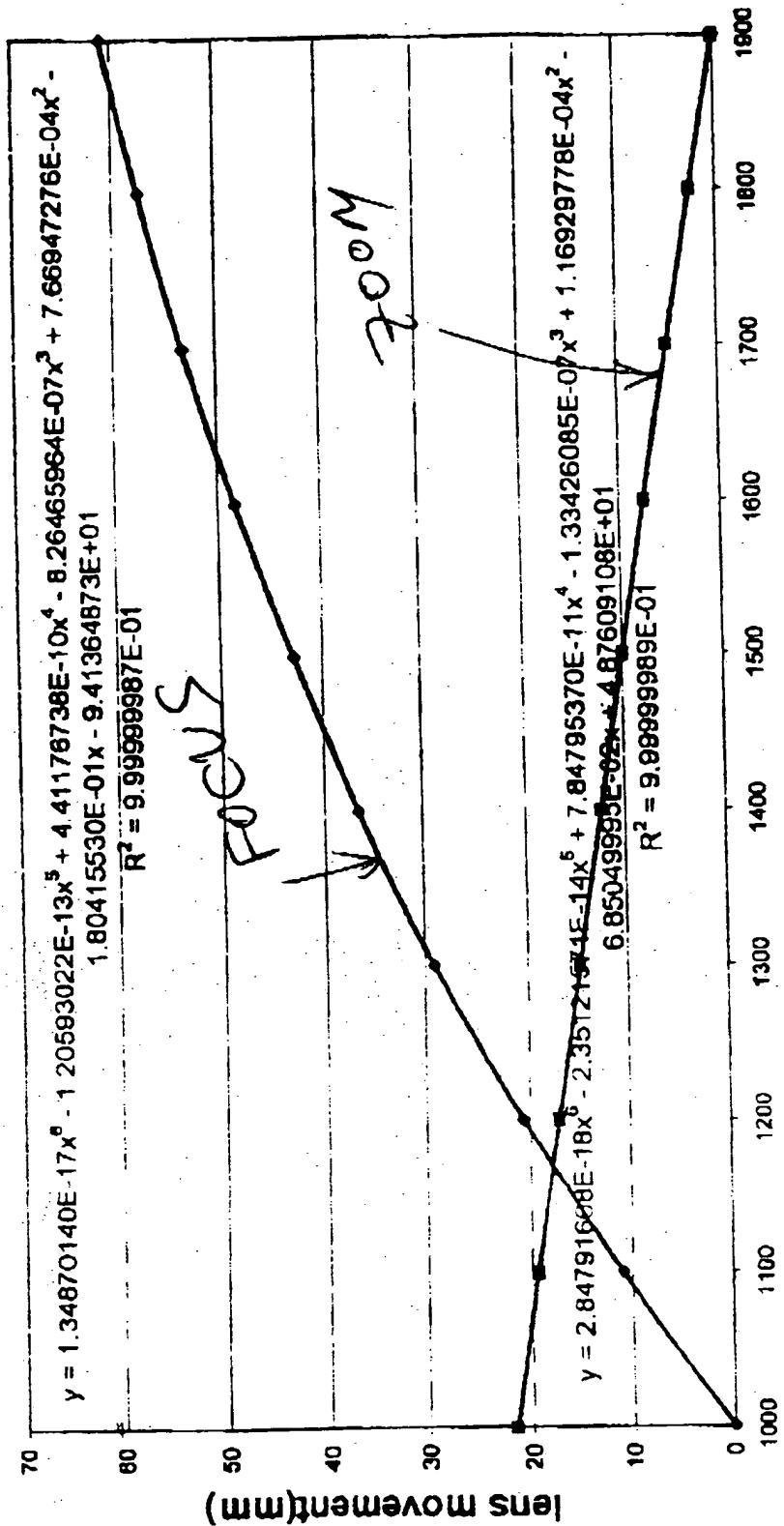
(use
interpolation
technique
for lens
distance
between
points in
table.)

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FIG. 27

Camera has a
fixed aperture F5.6

Focus and Zoom lens movement vs. working distances



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Focus

Zoom

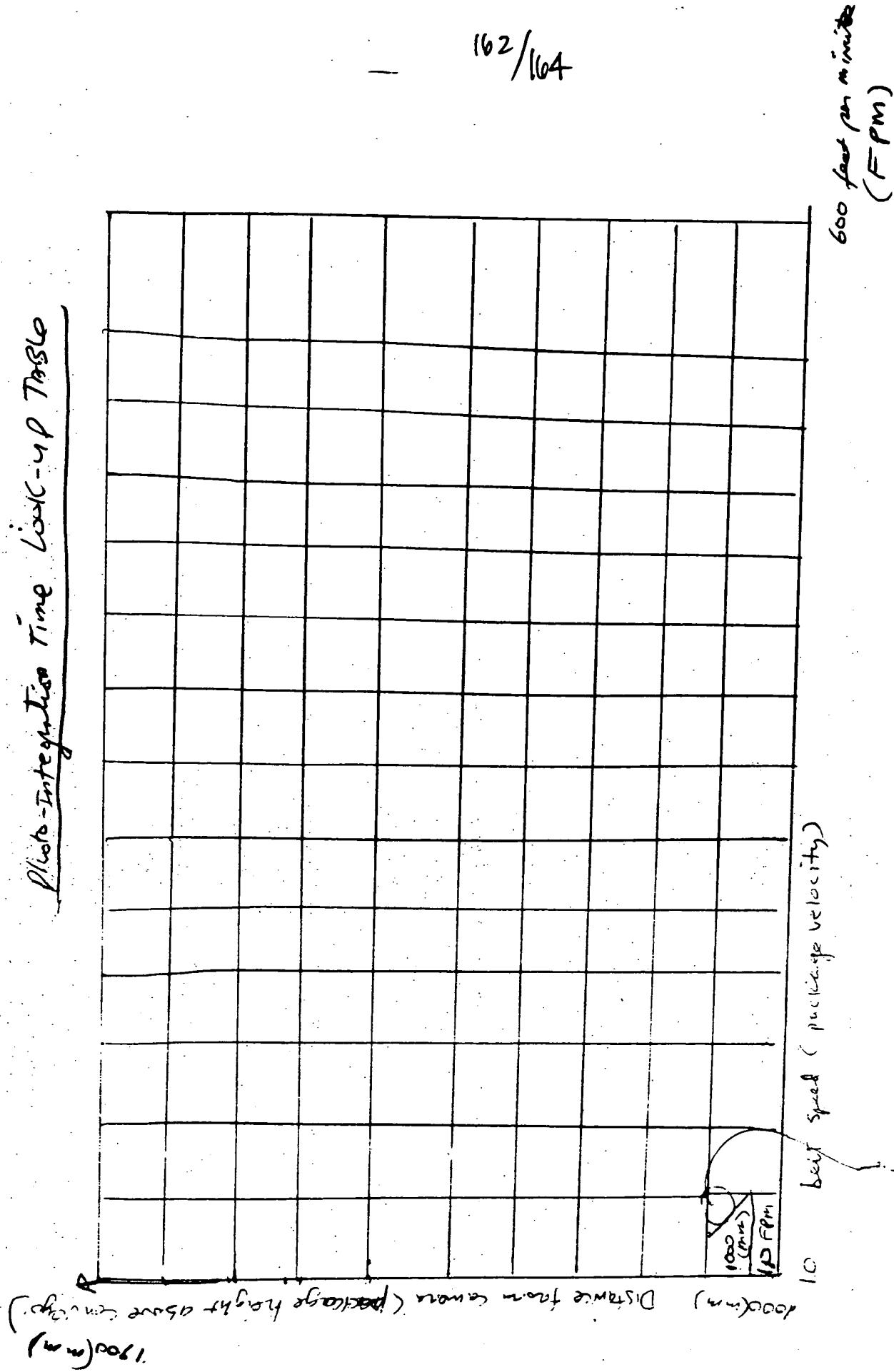
36" above conveyor belt
(inches)

← package height above conveyor belt

Conveyor-belt
surface

Fig 28

Object-Integrations Time Look-up Table



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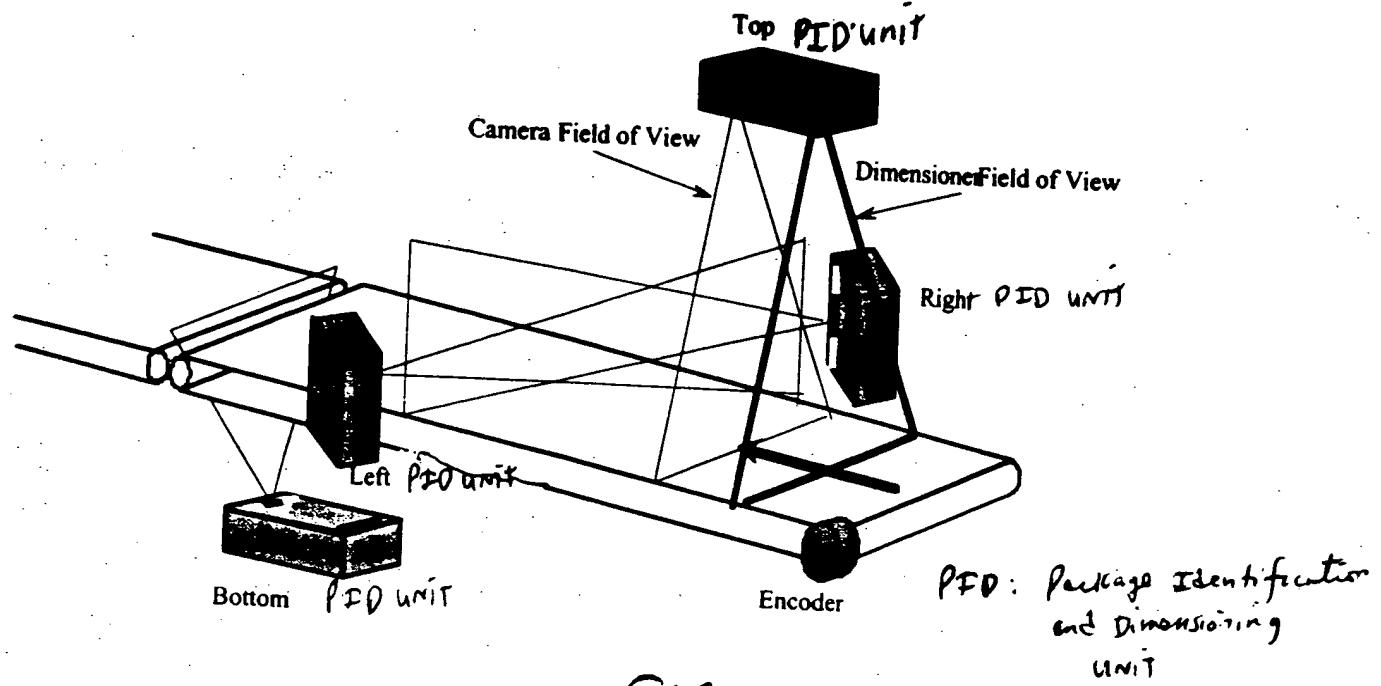


FIG. 30

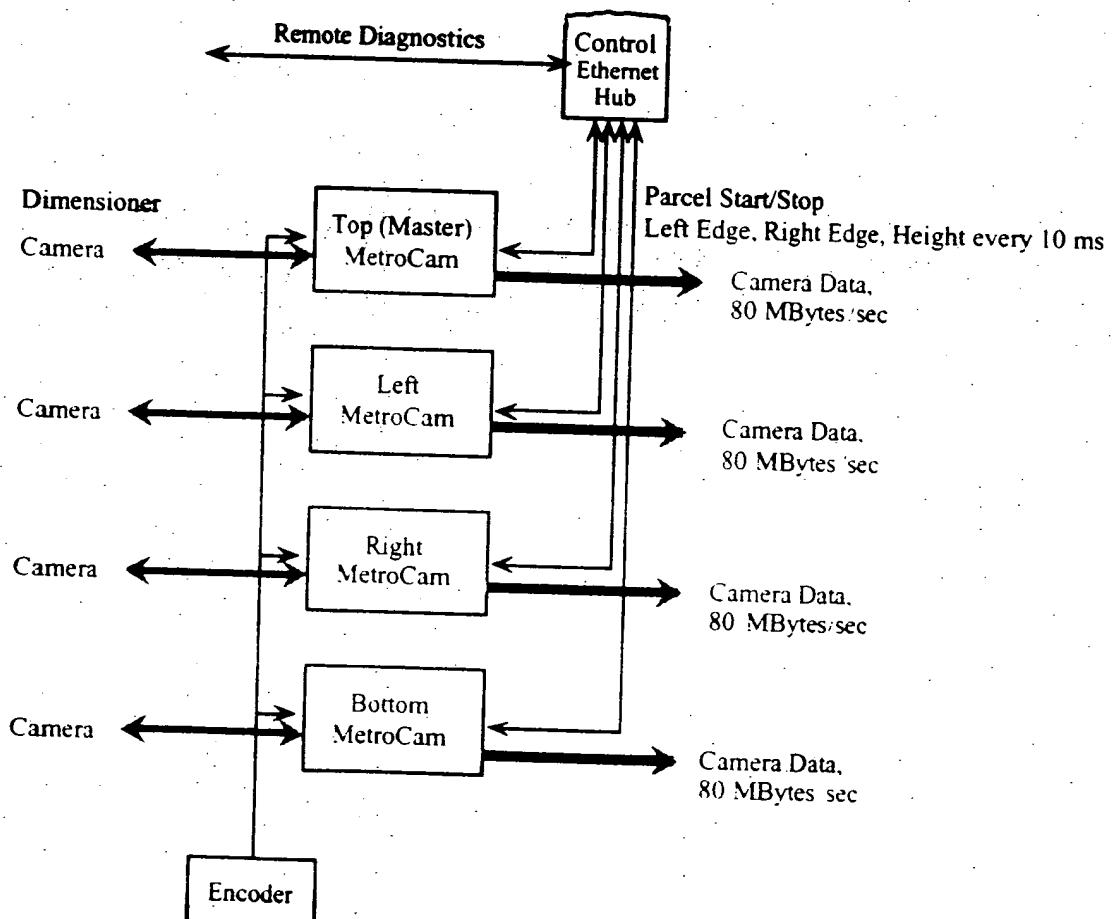


FIG. 31

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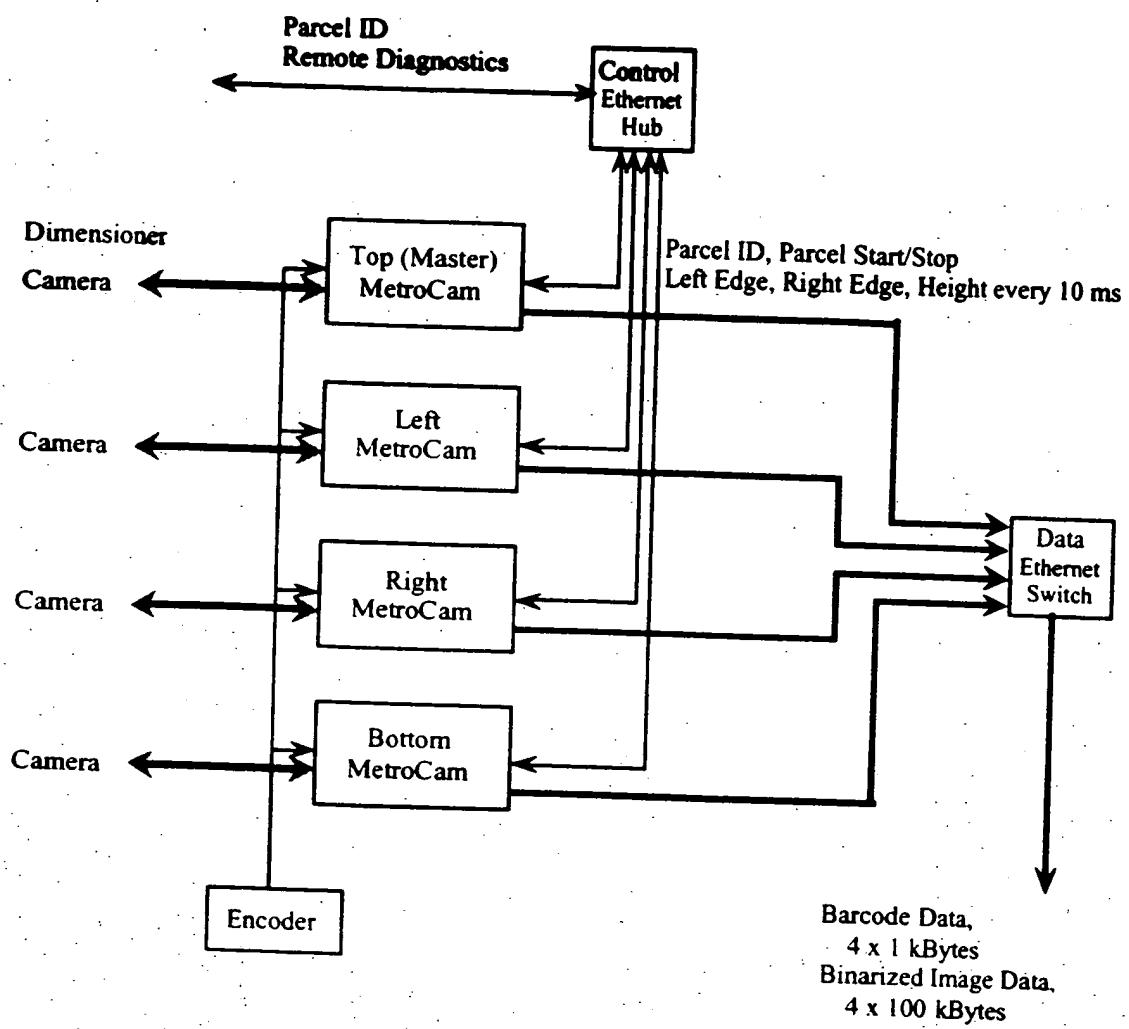


FIG. 32